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POPULAR MECHANICS

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If you must use a circular saw–

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A bargain saw may not be a safe buy!

New Wen Stallions were created with superior safety factors as a primary objective. Stability, necessarily a part of safety, results partly from front end adjustments that permit the saw to be tilted toward the rear. Your hand is always behind the blade for better cutting control. Heavy cast aluminum depth quadrants plus extra rigid steel angle quadrants assure stability at any depth or angle of cut.

Perfect balance means safety, too. With it you're never "fighting" the saw—no matter what the depth or angle of cut. And the Stallions' low profile indicates its low center of gravity. This, plus the full contour, one-piece handle, keeps the proper down/forward ratio of cutting force behind the blade shaft at all times. This special design aid contributes greatly to precision cutting and safety.

Precision engineering inside and out—heavy duty bearings, high efficiency motors, rigidly braced shoe plates, ZERO depth and angle adjustments, blades of higher quality than are normally found—all these make major contributions to operator safety.

Other built-in safety features are anti-kickback clutch, sawdust ejector, powerful blower clears line of cut, and a heavy-duty cord that stays clear of the saw blade and work.

Your choice of a 12 amp—2½ H.P. motor; or a 10 amp 1¾ H.P. motor. All Wen tools are U.L. and C.S.A. listed.

Ask your dealer about the price — you'll be pleasantly surprised.

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When calls come in, reach—don't run.

Ordering materials? Do it on the spot where you can spot what you need.

And if you don't object to being a household hero, here's an idea: Share the telephone convenience.

Find a spot for your extension where the family can use it too. Near your bench and near the laundry room or game room, for instance.

Remember, an extension phone really gives you your money's worth. It costs only a fraction of the monthly cost of your first phone.

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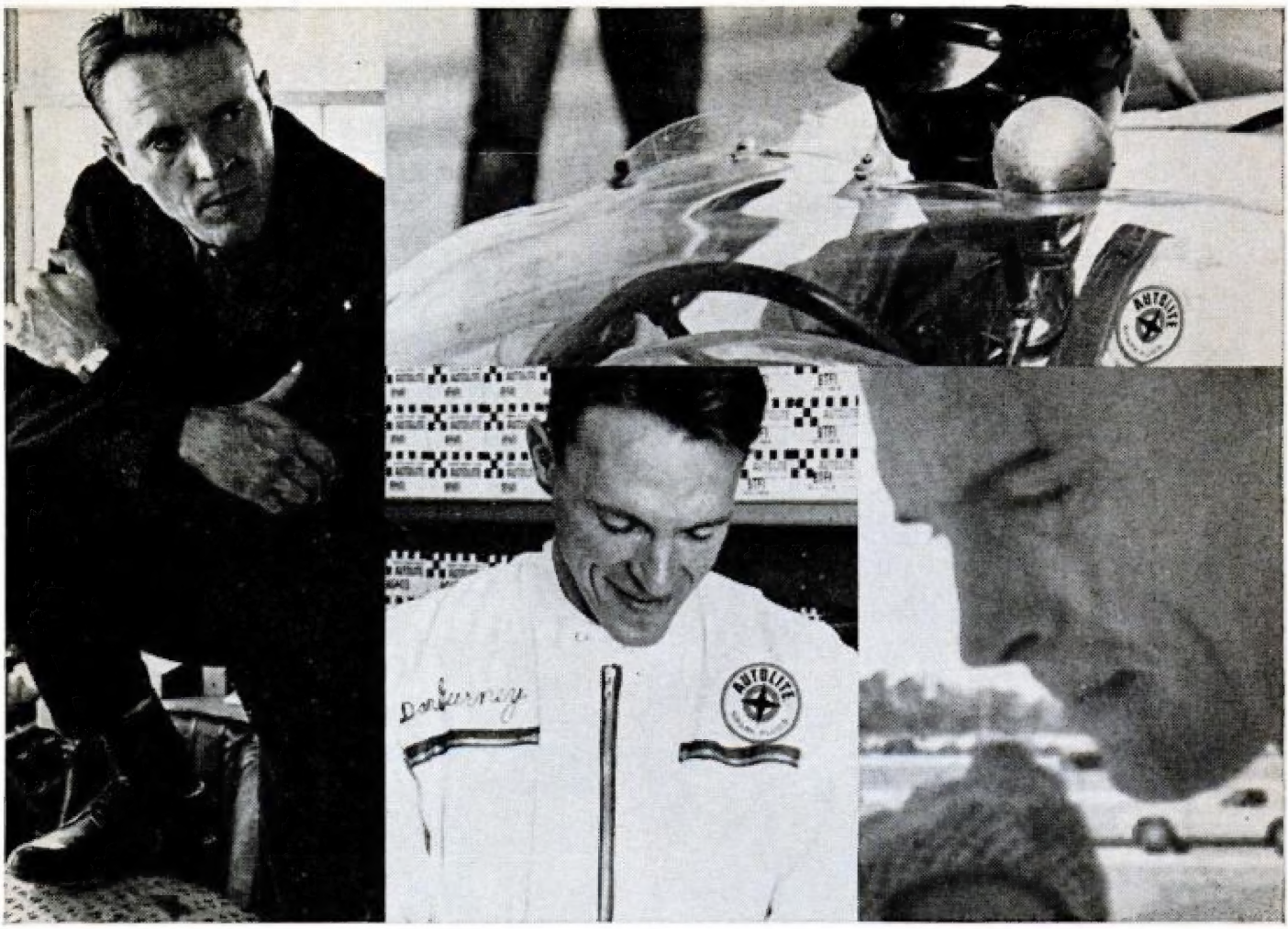

Dan Gurney, Grand Prix driver and three-time winner of the Riverside 500, tells you

"How to improve your car's performance without raising the hood..."

Blow out your engine on a fast stretch of highway . . . it helps get rid of carbon in the combustion chamber and cleans plugs of deposits that result from slow driving and idling. But take care. Lead deposits that form on plug insulators become conductive if heated rapidly, shorting plugs and causing misfiring. What's more, the deposits may become so badly fused that you can't remove them even by cleaning. Then it's "goodbye," plugs!

So don't just stand on it all of a sudden. Accelerate slowly. And stay within safe, legal limits. With today's "long" axle ratios that let big V8 engines loaf along, you might have to run in an intermediate gear to get the cleaning job done.

Power Tip plugs, pioneered by Autolite, all but eliminate the spark plug problem. Autolite Power Tip plugs have long insulator tips and electrodes that extend further into combustion chambers. The result is that swirling gases and higher tip temperatures keep Autolites freer of deposits—keep power and economy at a peak longer.

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Place your face here and go 'z-z-z-z-z-z-z-z.'

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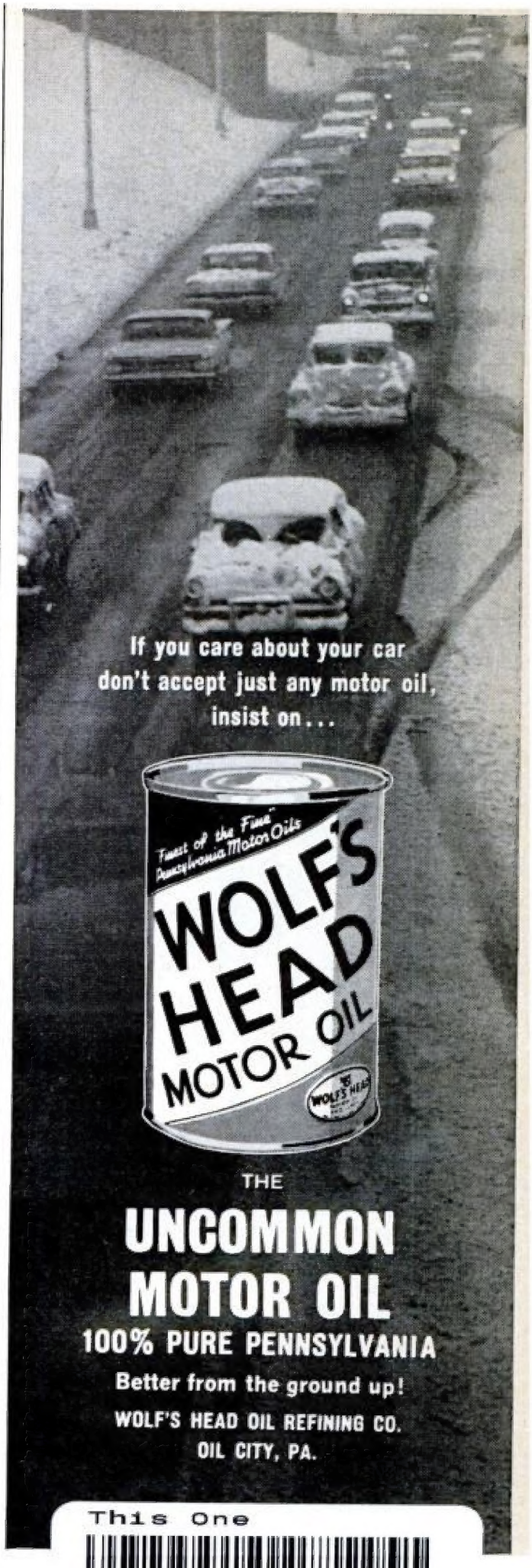

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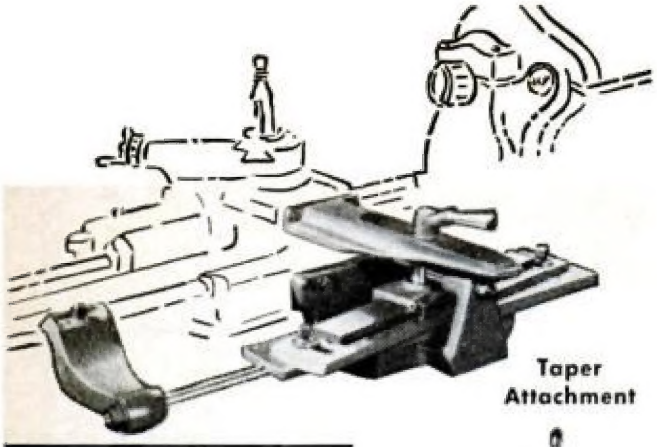
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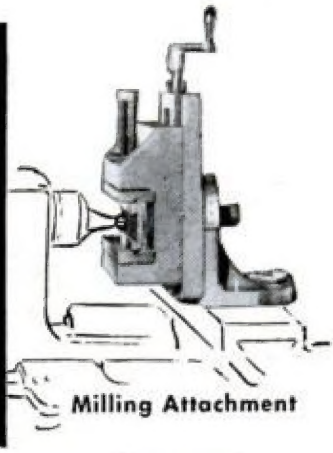
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LETTERS TO THE EDITOR

Brakeless Stopper

In *Fast-Reflex School for Patrolmen* (page 96, August *PM*), the author said that one of the fastest ways to stop a car when the brakes fail is to pull it off the road.

Due to an unfortunate action of mine, I found a quicker way to stop: Simply shift into reverse. You may end up with a ruined transmission, but, as you said, it's better than a busted skull.

Justice, Ill. LAWRENCE GESTAUT

We didn't try it, but our New York auto editor, Alex Markovich, checked out the technique with an engineer. His verdict: It works, and it won't necessarily ruin an automatic transmission. However, with a manual box, chances are you wouldn't be able to get into reverse at speed.

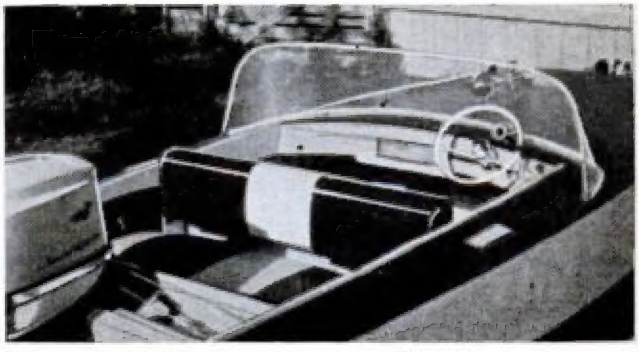
A Thrill to Hit the Throttle

The frame of our *Hydro Dynamic* (page 144, March 1963 *PM*) was constructed of mahogany and covered with the best non-marine plywood we could obtain. We strengthened and modified the transom to handle our 75-hp motor.

The entire hull is fiberglassed and finished inside and out with red and white epoxy marine paint. The seats are full-width spring-cushioned auto seats from the rear of two Ramblers.

With a standard prop, 12 gallons of fuel

(Please turn to page 10)



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TOM McCAHILL ADVISES SATURDAY MECHANICS

If you're a Saturday mechanic, my guess is you can fix the screen door, build lawn furniture, overhaul the kid's bike, and rotate your own tires.

It's a different story when that fancy electric coffeemaker stops perking or the push-button automatic washer quits halfway through a cycle. You might spend an afternoon admiring the coffeemaker's innards before giving it a permanent vacation on the top kitchen shelf.

As for the automatic washer, after the Little Lady shouts "Do something!" you'll end up phoning an Appliance Serviceman across town. He shows up in 3 days and has the washer going in one-fourth the time it took you to study the coffeemaker. He also presents you with a ticket for 30 bucks. When you consider he could make twice that selling you a new machine, you got off easy.

Maybe you never realized it, friend, but you have more Appliances around your hacienda today than you did five years ago. If you count power tools, your wife's hair dryer, an air conditioner, plus the standard stuff like vacuum cleaner, toaster, refrigerator, freezer and so forth, you probably have well over a dozen.

These electrical gadgets nowadays represent a pretty good chunk of your hard earned dollars. Did you ever stop to think it could pay you in savings and convenience to know how to fix these things? Also, it could be a great source of extra income if you're inclined to tackle the few thousand broken Appliances right in your own neighborhood.

The Appliance Repair business is easier to learn than you imagine. The National Radio Institute's Appliance Division has a downright interesting, low cost course you can take in your spare time. It covers every type of Appliance you can think of plus air conditioning, refrigeration, house wiring, electric motors—even small gas engines. There's a worthwhile section on farm and commercial appliances too.

NRI starts you with the basic principles of electricity to give you a solid background. Using clear-cut picture diagrams, they show you how various types of Appliances work, separating each into groups. Included with the course is a topnotch, professional Appliance Tester for fast trouble-shooting.

Easy to read, bite-size lessons are loaded with photos and cutaway drawings so you see how each Appliance comes apart, and more important—goes back together in working order.

Whether or not you agree that knowing Appliance Repair could help you, I recommend you see for yourself. The little coupon below will get you a free book that fully describes this unique home training. It also brings a free sample lesson. No salesman is going to call.

Do yourself a favor and mail the coupon today.

Tom McCahill

TOM McCAHILL

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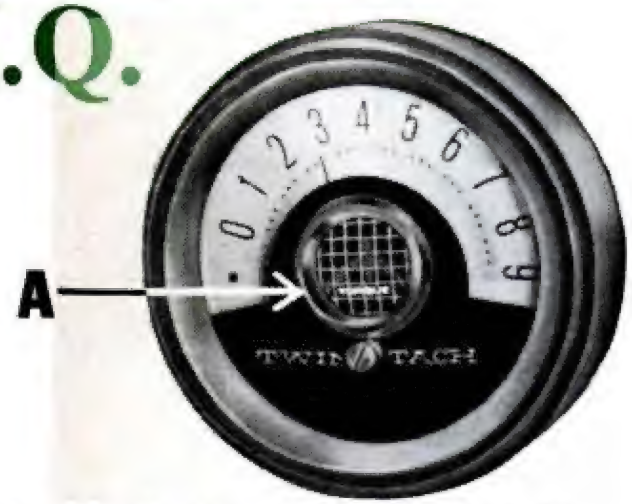

The second scale marked A on this tach measures what?

What does this symbol stand for?

Scale shows torque peak at which an engine produces the most pulling power. The life preserver means Quaker State Motor Oil—the best engine life preserver for your car. Made from 100% Pure Pennsylvania Grade Crude Oil, Quaker State helps keep your car on the road and out of the repair shop. To keep your car running young, always ask for Quaker State Motor Oil—by name.

QUAKER STATE OIL REFINING CORPORATION
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and two or three aboard, it will easily do 40 mph. It's really a thrill when you hit the throttle and she climbs to her points.
Fleming, Colo. LLOYD AND TERRY ROWAN

No Grabber

Just last week my son had the same experience as Mort Schultz reported in *Money Grabber* (page 182, September *PM*). His 1963 Rambler Classic, which was just two months over the 24-month guarantee, was using excessive amounts of oil. The manufacturer installed new valve seals without cost.

It's also interesting to observe that the factory felt that the type of grease used on the front-wheel bearings of the full line of 1963 Ramblers would not stand up—and then notified owners and repacked the wheels without charge.
Springfield, Mass. WILLIAM B. READ SR.

Spooklights and Flying Saucers

So you asked a couple of mechanical engineers to answer a problem in meteorology (*PM Tracks Down the Ozark Spooklight*, page 116, September *PM*). You got a mechanical answer, and you deserved it.

I would like to know why lights in the sky are always "explained" by calling them balloons, airplanes, planets, spaceships, or reflected headlights. (Of course, there's the ever-popular temperature inversion bit, but that works only on radar.) The solid-object answer seems to make the technicians happiest.

I've seen "flying saucers" twice. And I've reached the conclusion that the objects were not solid and had no control over the direction they traveled or the speed at which they traveled. They most likely came into existence as negative electrical charges generated by atmospheric conditions.

The next step in their becoming visible would be an air current containing an amount of dust with a positive charge. As the air current reached the area of negative charge, the charge would be attracted by the positively charged dust particles and pulled into the air current. The resulting display of light would be forced to follow the air current, moving against the wind.
Chicago, Ill. D. BRUCE BERRY

Okay, you can have your way with flying saucers—but we'll stick with Author Bob Gannon's explanation for the Ozark Spooklight. It's automobile headlights.
THE EDITORS

New Nailless Royalcote Panel Application System

takes the hard work out of paneling a room

New Royalcote general-purpose adhesive quickly and permanently affixes Royalcote Panels in place. No unsightly nail holes. Apply with caulking gun over solid backing, furring strips, or studs.

Large, precision-cut Royalcote Panels are made to order for do-it-yourselfers. Easy to handle, easy to line up. They cover a wall in no time flat. Adhesive forms a permanent bond, dries quickly, yet allows adjustment.

Finish the job with Royalcote color-matched moldings. Your choice of metal, or vinyl-covered wood, including base, cove, casing inside and outside corners. Moldings also can be applied with Royalcote Adhesive.

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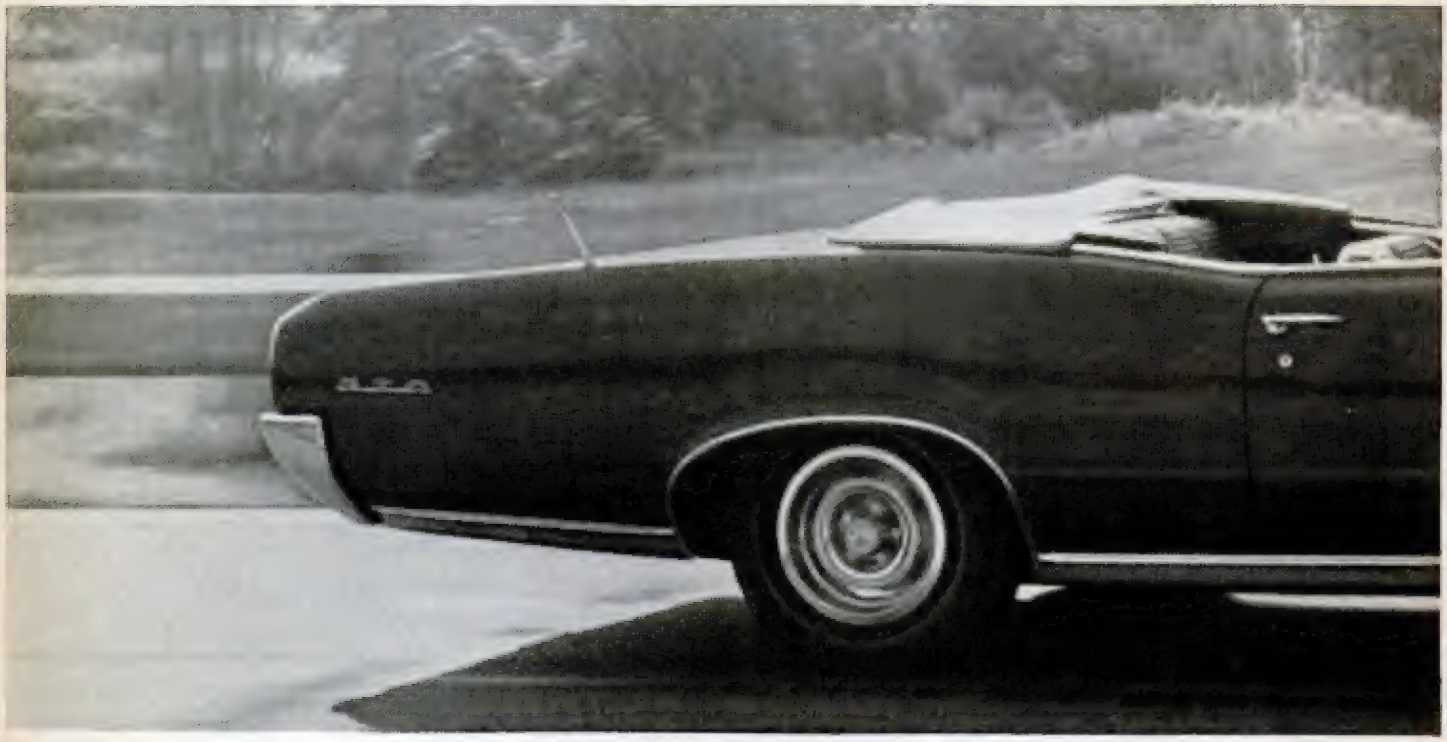
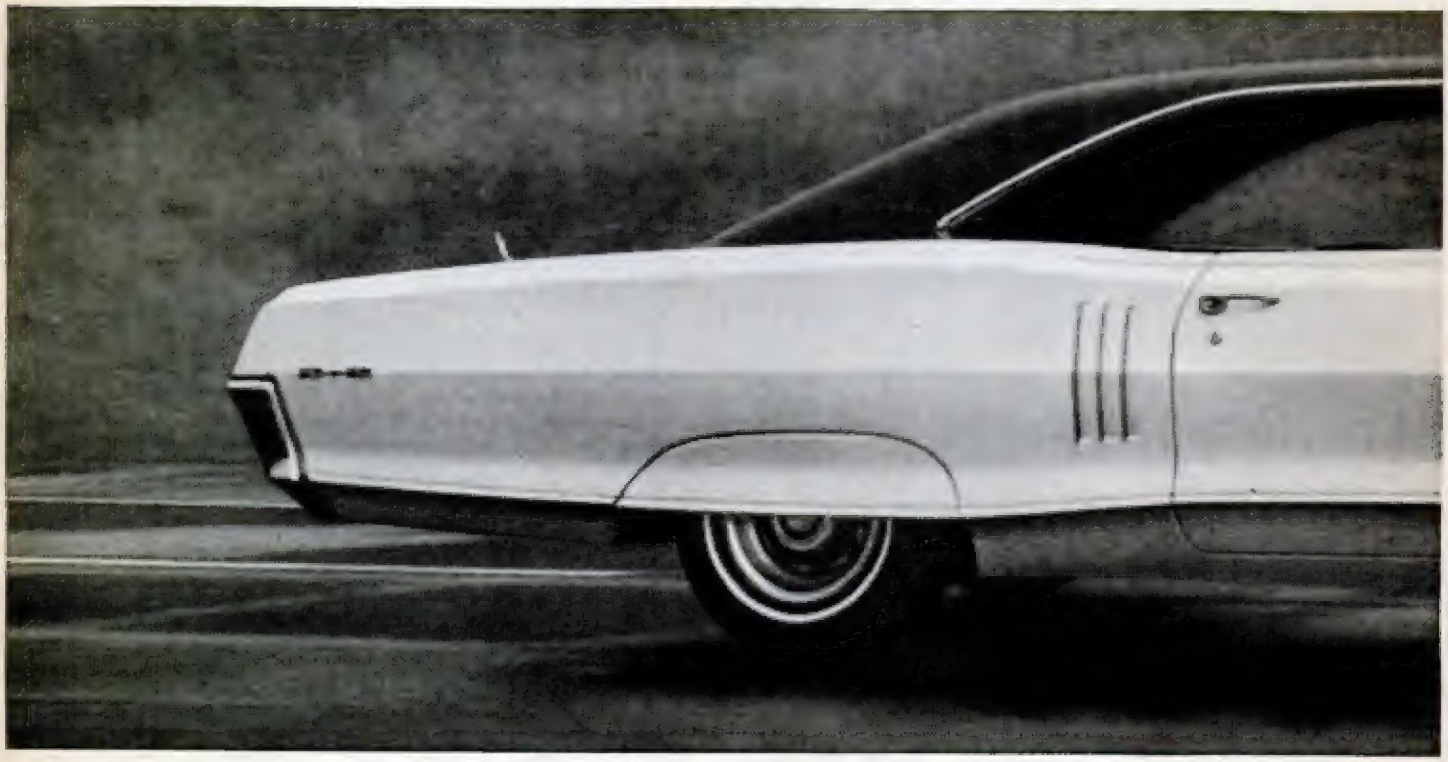


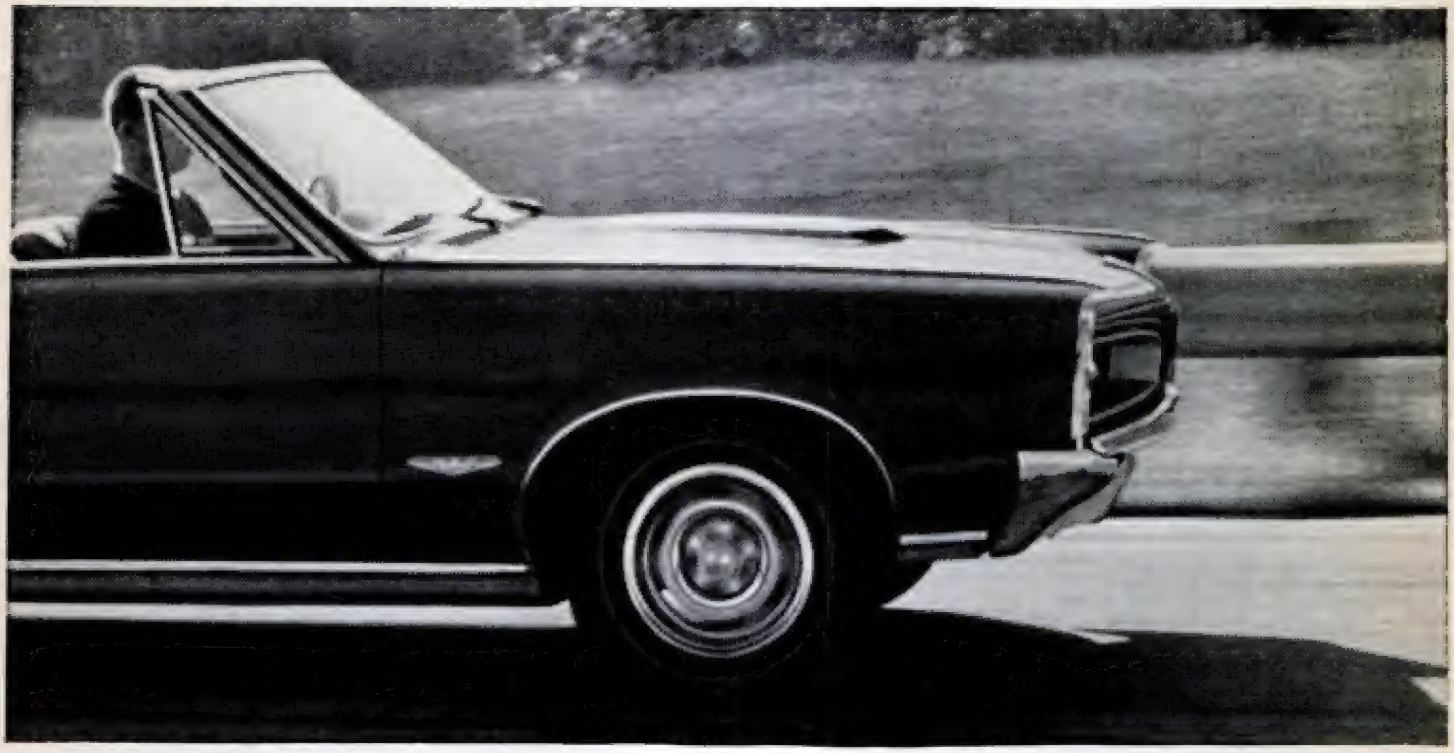


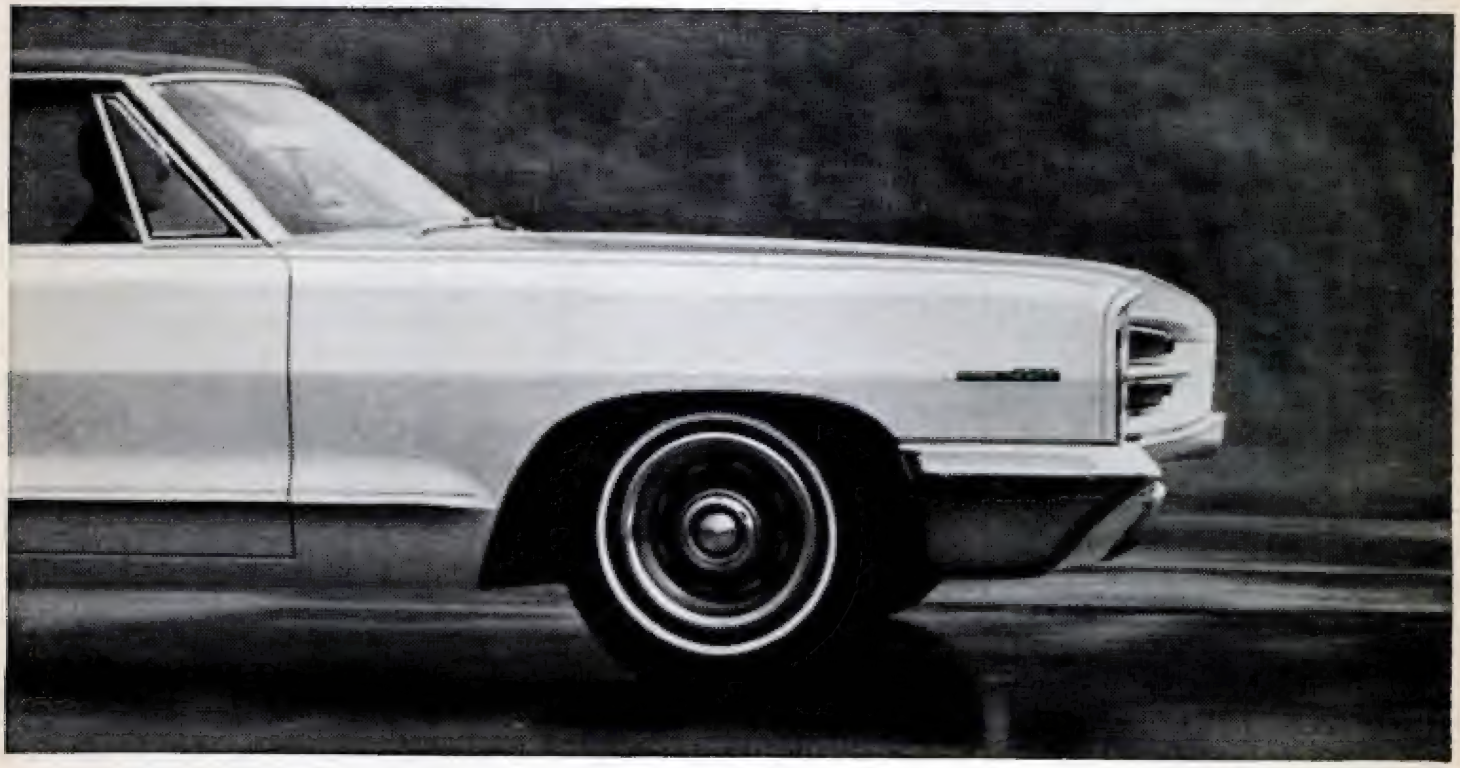
That heroic time-machine you see on top is the new *Gran Turismo Omologato*, otherwise known as the redoubtable Pontiac GTO. Under its hood is a 335-hp engine with quad carburetion that delivers torque as if the supply were limitless—431 lb.-ft. at 3200 rpm. There's a 360-hp version with 3 2-barrels. Standard box is a 3-speed all-synchro column shift. Heavy-duty 3-speed or four-speed are available, both with Hurst floor shifter. New buckets are practically wraparound. Suspension? Heavy-duty, of course. Options? You name it, we've got it. Probably chromed.

Below the GTO is its illustrious counterpart, the Pontiac 2+2. Its standard 421 cubic inch engine delivers 338 hp and 459 lb.-ft. of torque out of a four barrel. And you can specify up to 376 hp with a tri-carb. Like the GTO, air cleaner and rocker covers are chromed, body pinstriped. Inside there are enveloping new buckets, carpeting, an all-synchro 3-speed floor shifter.

And remember we practically invented performance options. For the last word, see your Pontiac dealer and get the GTO/2+2 catalog.

Pontiac Motor Division • General Motors Corporation





The tiger scores again! Wide-Track Pontiac/'66

Since when is a six a surprise?

In its 165-hp form (standard on all Tempests, Tempest Customs, and LeMans), our new six isn't going to surprise many people. Even if it is an overhead cam job. But don't knock it. Only a dozen years ago, engineers were busting their bearings to squeeze that out of a production *premium gas* V-8. Our six does it on regular.

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You can order the 207-hp package in any LeMans, Tempest Custom, or Tempest (except wagons). Read more about this new kid on the block in the GTO/2+2 catalog.

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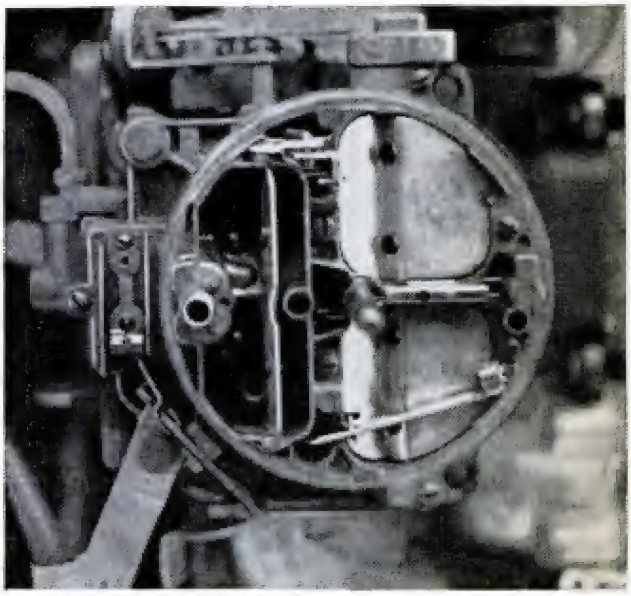

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NEWS FROM THE MILITARY

BY WILLIAM R. KREH

The female leg and antitank missiles now have something in common—nylon stockings. The Army needed a covering for missile launch tubes. It had to be a sheer, fine-mesh fabric capable of stretching four or more ways at once. Chemists started experimenting and found that chemically-treated women's hosiery met the need like nothing else on the market.

An obsolete weapon that was shelved by the Marine Corps in 1956 has found new life in Vietnam. The 60-mm mortar was replaced by the 81-mm mortar in 1956 because of its longer range. The 60, however, is lighter, easier to handle and can be carried in one piece on patrol. It's been found an ideal support weapon for Vietnam combat patrols.

Ocean depths down to 56,000 feet will be simulated in a new pressure tank being built by the Navy at Annapolis, Md. The tank will be used to develop and test equipment such as submarine machinery, salvage and rescue devices, mechanical operating arms and pressure capsules. It will be finished in 1967.

Navy drill. When a vital part of the guided missile system of the USS *Providence* refused to work recently, it appeared the cruiser would be late for operational tests. It was found that a fine strand of wire had pulled loose; alloys in the wire weren't adhesive to solder. The weapons officer, Lt. Cmdr. Jack Griffith, had an idea and called on the ship's dentist, Lt. Cmdr. R. E. Howe. The dentist drilled several holes and packed the wire into them with amalgam, a substance used for filling teeth. It worked perfectly and the *Providence* was on time for her tests.

Edible as ever. Five World War I emergency rations recently received by the Army's Quartermaster Museum at Fort Lee, Va., have been found to be still edible. Packed in metal containers, each ration consisted of a half-pound bread and meat item, three one-ounce chocolate bars, a gram of pepper and three-fourths of an ounce of salt.

Other still-edible rations acquired by the museum include hardtack crackers from the Civil War and soup from the Greely Greenland expedition of 1884.

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BY JOHN F. PEARSON

SCIENCE WORLDWIDE

Hula hoops — remember them? — are back. But this time they're not being twirled. NASA engineers have found that the hoops, cut apart and with one end plugged, make ideal storage tubes for wire used in building the triggering systems for atomic-powered engines. Advantages are portability, easy storage and quick identification of the wire because of the hoops' bright colors.

Flame throwers and poison gas are being used in a campaign in the mountains of Mexico's Chihuahua State. The enemy: giant vampire bats. Attacks by bats, according to press reports, have resulted in the death of one child and sent dozens of other victims to the hospital. Villages are being supplied with rabies vaccine.

Hippo pie, buffalo goulash and elephant sausage will soon be on menus in the new African nation of Zambia. The country has an overabundance of wildlife, and a game-cropping program is expected to put about 900,000 pounds of meat on the market. The step is also calculated to improve the average diet, which is desperately light on protein.

Higher and higher. The population of the U.S. will hit 200 million around May, 1967, according to the Population Reference Bureau of Washington, D.C. If our present rate of growth continues—it's about 7200 a day—in 60 years our population will be roughly the same as India's is today: about 500 million.

A two-mile-long laser beam has been folded into a 10-foot space by reflecting it more than 1000 times between two mirrors. The experiment by Bell Telephone researchers provides a new way of measuring very small losses of light in lenses and other optical materials.

Sharks in the desert. Fossils of four species of shark were recently found in the barren area of Israel known as the Negev. About 130 million years ago, say Israeli scientists, the Negev was covered by a warm sea.

Atomic-age roadbuilding. California's Division of Highways is using a small black box called a nuclear density and moisture tester in constructing new major roads. The instrument, which is operated only by AEC-licensed state employees, is designed to test roadbed compaction, one indication of how well the highway will stand up under the pounding of traffic.

An electric fish counter has been installed in a dam on Britain's River Leven. In a small gap in the dam, through which fish make their way, scientists have put a fiberglass tube fitted with band electrodes made of stainless steel. Fish passing through the tube cause a change in the resistance to the current between the electrodes, activating a tally mechanism.

Second largest known meteorite in the world may be removed from Greenland and put on display in Denmark. The 15-ton meteorite, discovered by a Danish engineer, is thought to have embedded itself in glacial ice some 10,000 years ago.

Astronauts returning from future space flights may be scooped out of the water instead of being hoisted by helicopter sling. NASA has developed a scoop attachment for helicopters for rescue and recovery operations at sea. The 175-pound device consists of a retractable rigid boom and net attached to the forward part of the helicopter. The boom is made of tubular aluminum and the basket of plastic-covered wire net.

A square-shouldered pineapple has been developed by Australian researchers. It is said to be juicier and contains less waste than the conventional round-shouldered variety—a boon to canners. The development follows five years of research and experiments with 25,000 pineapple plants.

Infrared sensors mounted on airplanes are being used by the U.S. Geological Survey to map fresh water that's leaking to the sea in Puerto Rico and the Virgin Islands. The sensors respond to the temperature difference between the fresh water and the sea water, with the infrared film showing a lighter tone for warmer objects. The scientists hope to spot the sources of the fresh water so that it can be contained to prevent it from escaping into the sea.

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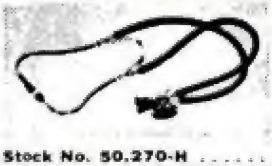

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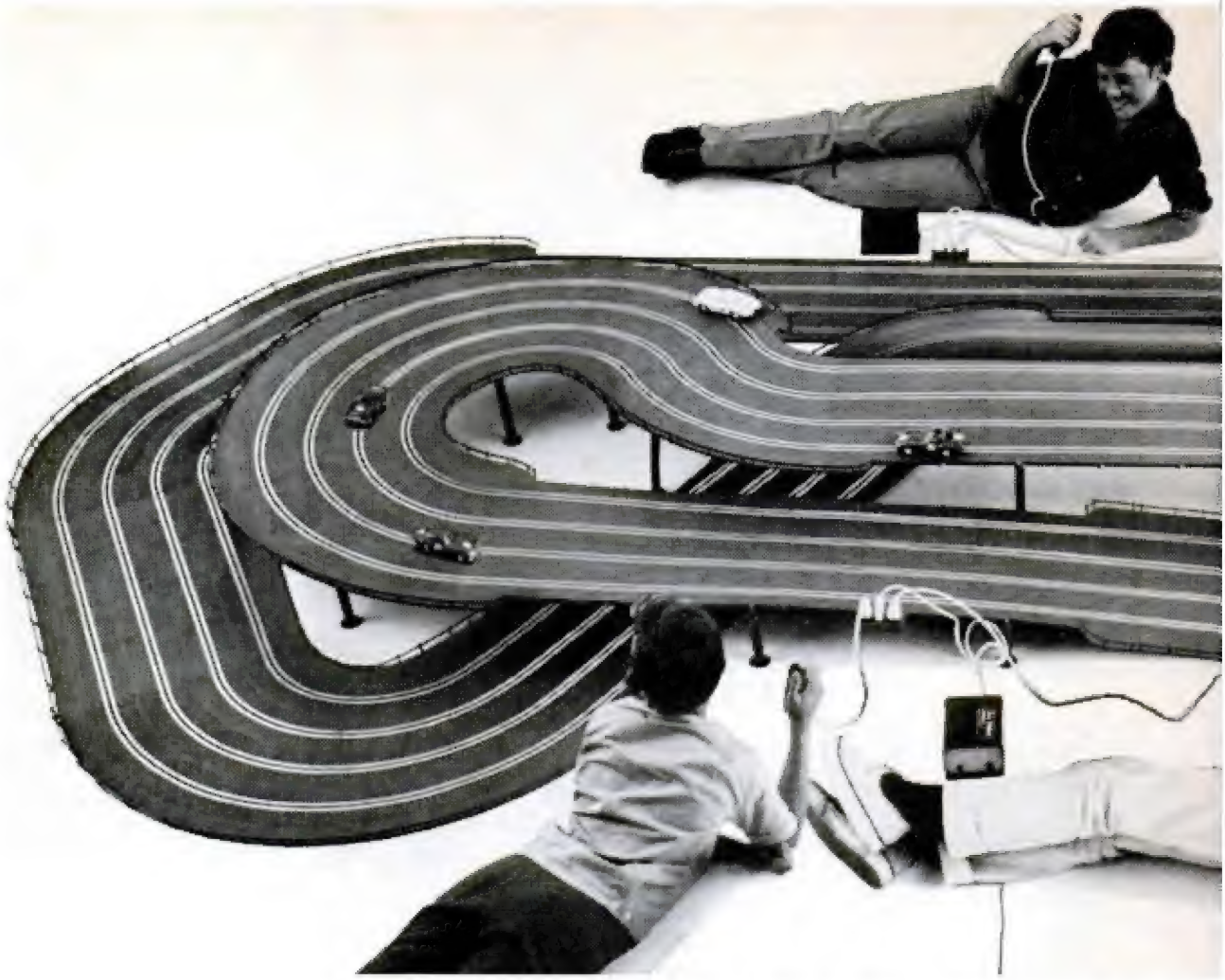

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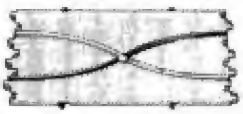

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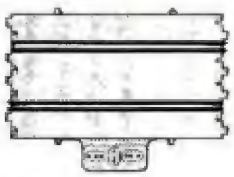

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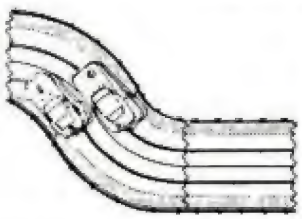

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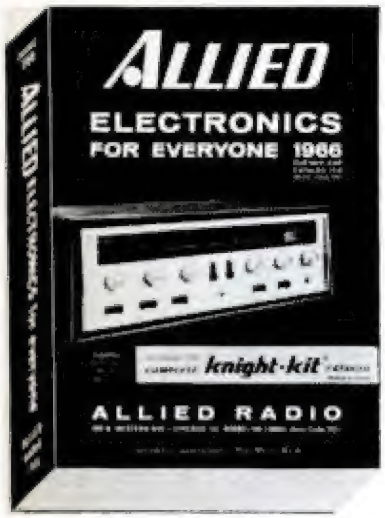

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FROM THE PATENT OFFICE NEW INVENTIONS

BY M. J. PEDERSEN

Giant "wastebasket" feeds on classified information from the Government's secret space and national defense projects. Toted around in a van under security guard, the disposal unit makes weekly pickups of some 300,000 pounds of classified garbage, chewing it to confetti-sized bits and pieces by a hammer-milling process. Easing a grave security problem of preventing such documents from falling into the wrong hands once their purpose has been served, the unit earned patent 3,192,853 for James E. O'Connor, Los Angeles, California.

Radioactive milk may be decontaminated by a process that utilizes a continuous ion exchanger. A polymeric resin is used to remove a radioactive ion in the milk and replace it with a nonradioactive one. Irwin R. Higgins, a former U.S. Atomic Energy Commission scientist, earned patent 3,194,663 for the process. The ion substitution does not otherwise alter the milk. If a new transportable unit is successful, it may become standard stand-by emergency equipment around the country.

Fruit pickers will be aided by a stretchable chute which will conveniently channel fruit direct from the picker in the tree to a truck or cart on the ground. With a funnel at the top end and a cushion at the bottom—to prevent fruit damage—the fruit chute earned 3,194,375 for Russell J. Callow, Sr., Ocala, Fla.

Eggshell membrane—the paper-thin layer between the shell and the white—hastens the healing of burns, according to patent 3,196,075, granted Dr. Irene Neuhauser of the University of Illinois Medical School, Chicago. After the membrane is pulverized, the pulp is formed into a sheet that can be placed over burns.

Make America beautiful—the program may be given a helpful nudge by a portable machine that ruthlessly chops up junked cars. Joseph R. Mordan, Alden, N.Y., received patent 1,196,726 for the auto chopper, which could eliminate the eyesores of automobiles abandoned along the roadsides. Two or three men using the new unit can do the same job as 15 men working with acetylene torches.

KENTUCKY STRAIGHT BOURBON WHISKEY. 86 PROOF. CANADA DRY DISTILLING CO., NICHOLASVILLE, JESSAMINE COUNTY, KY.

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WHAT'S NEW OUTDOORS

BY STUART JAMES

No trespassing signs in the forests of three northwestern California counties have been replaced with a triangular "welcome" sign that identifies 260,000 acres of forest opened to public recreational use by the California Redwood Assn. Nine lumber companies are cooperating in the program, and the symbol was designed to represent three groups involved, landowners, recreationists and the government. Twenty-four areas in Del Norte, Humboldt and Mendocino counties offer free picnicking, hiking, camping, swimming, beachcombing and hunting. This is part of a new trend in industry to take an interest in recreation and conservation, and we applaud the lumbering interests. Historically, industry and conservation have been natural enemies. I am reminded of a classic example—the depleted fishing industry in Monterey, Calif. Some years ago a team of biologists was retained to answer the question: What happened to the sardines? After a year of research they made their report: "They went into cans."

Fishing worms and how to get them without digging for them is something that seems to occupy the minds of anglers. Dick Kelly of Houston, Tex., sends us the latest suggestion and it's called stobbin.' He came across this method when he was fishing the White River in the Missouri Ozarks. "You need a large pail and a sledgehammer," he writes. "Then you just go out in the woods, put the pail down and start beating on boulders, stumps, logs and tree trunks with the hammer. The worms come rushing out to see what in hell's going on, and you gather them up and put them in the bucket."

Boondocking on a lightweight trail bike such as the Honda and Yamaha ceases to be fun when you have to change back for street use, a greasy half-hour job of undoing the chain, moving it over sprockets, then reinstalling it and adjusting the tension. But now, with a new device installed, you can make the switch simply by throwing a lever. Called the Go-Matic, it has three small sprockets between the transmission and the two rear sprockets. The engine drives a center sprocket, which is shifted by a lever to drive one or the other of the rear sprockets. It comes in kit form from GO Corp., 1905 Bay Rd., Palo Alto, Calif., and is priced from $43 to $64.

So why should *you* waste a perfectly good winter? You'll find it's more than bearable with a Johnson Skee-Horse to take you up hill and down, cross country at an exhilarating 30 mph (or better), into territory that used to be off limits when the snow flew. You can hunt and fish with a Skee-Horse, go camping with it, pull skiers with it. Some folks even hold Skee-Horse rallies and steeplechases. It opens a whole new range of winter pleasures — so get with it. Before the woods are full of bears on Skee-Horses.

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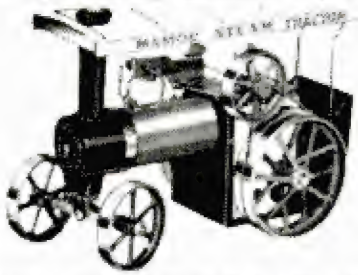

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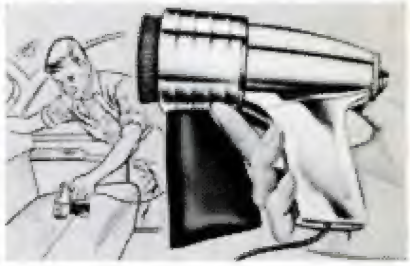

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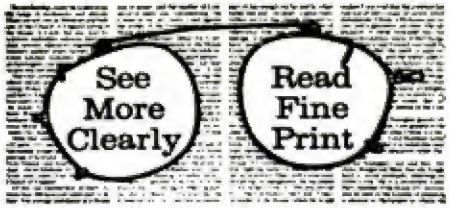

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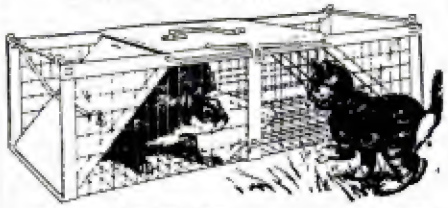

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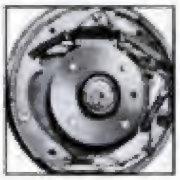

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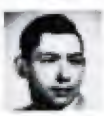

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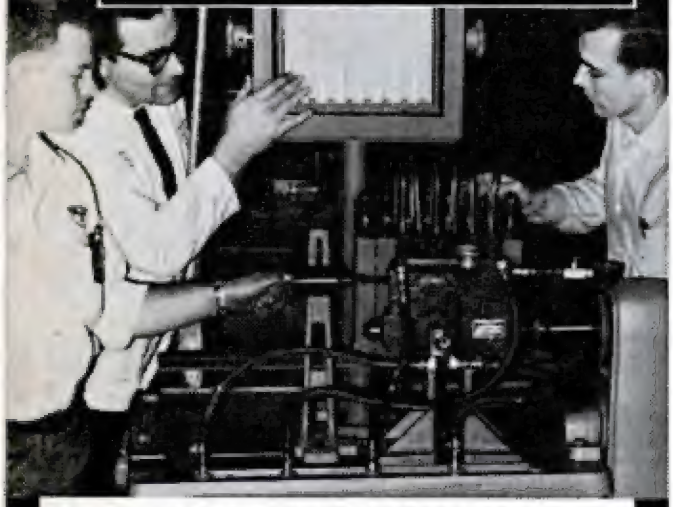

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BY KEVIN V. BROWN

AVIATION

JETSTREAM

President Johnson, in announcing the go-ahead for the Air Force's manned orbital laboratory (MOL), created a long-awaited breakthrough on two fronts.

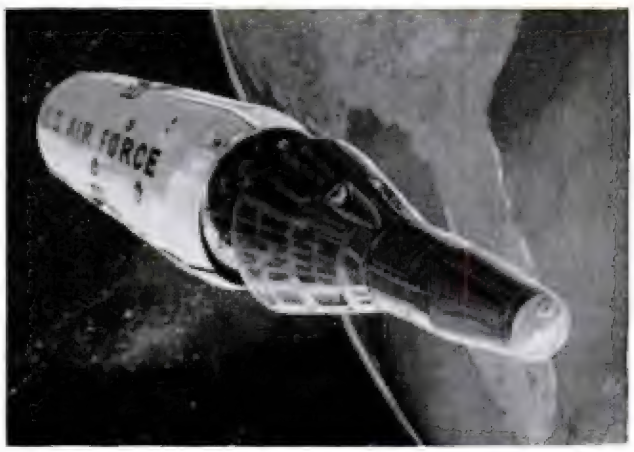
He approved, for the first time, sending military personnel into space on a military mission, and he opened the door for the re-creation of the U.S. Air Force as the U.S. Space Force, or perhaps Aerospace Force.

The MOL, which in preliminary drawings resembles a huge boiler, will be about 10 by 40 feet, big enough for walking room —or, in the weightless condition, floating room. The first tests will probably send two men into orbit for 30 days. The ultimate purpose is to find out what a military man is capable of in space.

The whole idea has been something of a political football. Some officials felt space should be left for peaceful purposes. Others felt that if we didn't send military men into space, with defense of the United States in mind, someone else might send their military men up with destruction of the United States in mind.

The new role gave new hope to the Air Force which, although less than 20 years old, was in some danger of becoming obsolete or at least being reduced to a minor role. Missiles have taken over many of the chores once performed by its fighters and bombers, and many of its pet projects, like the *Dynasoar* and the XB-70, have been cancelled or curtailed drastically. The F-111 is the first new frontline Air Force aircraft in almost 10 years.

Its Space Pilots' School has already contributed two astronauts (McDivitt and Borman) to NASA space missions. Now it may find roles for the others itself. The sky itself is the limit.



AIR FORCE MOL will be first military space mission

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"DREAM WORKSHOP" (PICTURED BELOW) INCLUDING ALL THESE POWER TOOLS—

DeWalt 10" Deluxe Power Shop with 14 accessories • New ⅜" Deluxe Variable Speed Drill with bench stand • Black & Decker ¼" Cordless Drill with Power Pack and Charger • New Professional Jig Saw Kit with 15 extra blades • 7¼" Deluxe Circular Saw with case, cut-off guide and 5 blades • New Dual Action Finishing Sander with dust collector and 30 abrasive sheets • Professional Belt Sander • 11-piece Router Kit • ½" Reversing Drill with drill press stand • Cordless Hedge Trimmer with Power Pack and Charger • and the Black & Decker Deluxe Lawn Edger & Trimmer with 100' extension cord. Also included are 40 drill accessories, 40 hand tools and all the Dream Workshop cabinets and wall units you see in the picture (designed by Popular Science for Black & Decker).

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1966 Fairlane

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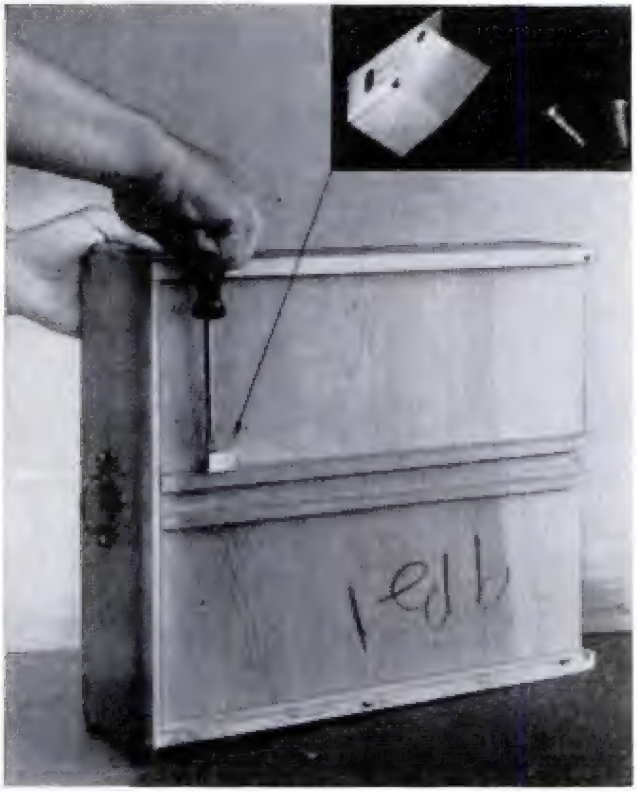

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CAREER BAROMETER

BY CREIGHTON PEET

RIGHT NOW, mechanical engineers—and the entire train of jobs they carry with them—seem to occupy one of the brightest spots on the career horizon. Why? Because they're needed by a booming U.S. industry for everything from electric toothbrushes to jet engines for the new 700 man transport planes—to say nothing of our fantastic manned orbital laboratory and other space projects. It's quite a range.

What's more, says John Hall, General Electric's manager of technical recruiting for the southeastern region, we're in a new cycle: the Government is busily buying *hardware* rather than pouring the horn of plenty into research for devising new systems. The big need now is for mechanical engineers in design and production areas. This means that the straight research and development men will not be as much in demand for awhile as they were, say, a year ago. The huge demand for hardware, which should benefit all mechanical men, includes not only tanks and other war materiel for Vietnam, the 700-man transport plane, and the much-discussed supersonic plane, but a vast number of small consumer items.

In current military hardware there is less demand for electrical and electronic men. Because of the nature of the war in Vietnam we can not use some of our most alvanced materiel, older items are often more useful.

This trend to continue the production of

(Please turn to page 46)

JOB TITLE	CURRENT DEMAND	3-MONTH TREND	STATES WITH HIGHEST DEMAND				
Chemists, Biolog.	28	Slightly less demand	N.J. 7	N.C. 2	Pa. 2	Ohio 2	Minn. 3
Chemists, Organic	51	Slightly less	Conn. 4	N.J. 9	Calif. 9	Ala. 11	Ohio 3
Chemists, Inorganic	7	Slight increase	Conn. 1	Ala. 2	Mo. 1	Colo. 1	N.M. 1
Engineers, Metall.	49	Some increase	Conn. 5	D.C. 6	Pa. 3	S.C. 10	Ind. 6
Engineers, Civil	447	Substantial increase	Conn. 30	N.Y. 52	D.C. 66	Calif. 58	Wash. 33
Engrs. Elect. & Electron.	879	Demand steady	Conn. 46	Calif. 219	D.C. 52	Fla. 96	Miss. 52
Engrs. Industrial	290	Good increase	Conn. 21	N.J. 29	D.C. 22	Wash. 20	Miss. 23
Engineers, Mechanical	1,055	Very heavy increase	Conn. 67	N.J. 59	Calif. 180	Pa. 70	Ohio 57
Engineers, Aero.	494	Good increase	La. 17	Calif. 123	Wash. 120	Miss. 153	Mo. 140
Engineers, Mining	14	Good increase	D.C. 3	Pa. 4	Fla. 1	Minn. 4	Calif. 1
Nat. Scientists	100	Slight decline	N.J. 4	D.C. 18	Va. 5	Ohio 4	Wash. 51
Draftsmen, Arch.	37	Some decline	Conn. 2	Mass. 3	N.J. 3	Pa. 3	Mich. 9
Draftsmen, Elect.	65	Very good increase	Pa. 6	Fla. 5	Ill. 4	Mo. 20	Calif. 20
Draftsmen, Mech.	185	Substantial decline	Pa. 34	Ohio 37	Ill. 11	Wis. 27	Mo. 10
Draftsmen, all other	195	Substantial decline	Conn. 15	Ga. 13	Miss. 21	Mo. 20	Calif. 36
Tool Designers	114	Substantial increase	Vt. 10	Pa. 4	Ill. 10	Wis. 5	Wash. 60
Lab. Tech. & Assts.	93	Heavy increase	Conn. 6	Mass. 5	Fla. 7	Miss. 15	Ind. 13
Sports Instr. & Officials	48	Good increase	Conn. 6	N.Y. 7	Va. 3	Fla. 2	Colo. 25
Surveyors	23	Less demand	N.J. 2	N.C. 3	Ill. —	Iowa —	S.D. 6
Techs., Engrs., Phys. Sci.	318	Some little increase	Ala. 52	Fla. 26	N.M. 10	Ariz. 4	Wash. 202
Tool Planners	12	Demand doubled	Miss. 3	Ohio 2	Ill. 7	—	—
Systems Engineers	22	Demand steady	N.Y. 1	Pa. 1	Fla. 2	Ill. 1	Mo. 15
Programmers	276	Substantial increase	N.J. 7	D.C. 24	Mo. 11	Calif. 61	Wash. 118
Systems Analysts	78	Demand steady	Conn. 4	D.C. 5	Mich. 4	Calif. 14	Wash. 35
Inspectors, Pub. Service	9	Good increase	Md. 1	Calif. 2	Alaska 1	Wash 5	—

PM's Career Barometer Chart, above, gives the actual number of men currently needed for specific jobs. "Current Demand" figures are true as of our closing date. Check this chart each month and it will tell you where your talents are needed, and how badly. For names of actual employers represented by these listings, contact the state employment agency in the capital city of the state indicated. Mention that you saw this in **POPULAR MECHANICS.**

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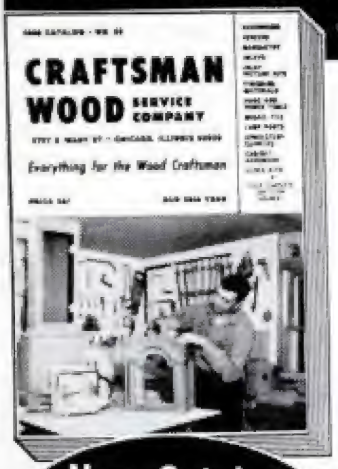

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CAREER BAROMETER cont'd

existing designs will also be seen in some civilian lines, Hall believes, since our present prosperity is causing an increased demand for everything from cars to boats. As a result, a good proportion of General Electric's men will at times cross over from the electrical field to the mechanical—and in some cases will stay in this field. The reverse was true when a mechanical man ventured briefly into electronics to develop a magnatron small enough to go into an electronic oven. But that was one item—not a trend.

David Fax, technical assistant to the vice president of engineering at Westinghouse, points out that mechanical engineers have been needed in the production of almost every piece of equipment from the projected nuclear powered rocket to improved electric motors and generators.

The Heat Is on Heat

One major problem in many new items, he says, is heat removal—a mechanical engineer's specialty. A generator's capacity, for instance, is limited by the temperatures it reaches. You can't just keep on putting in more and more mechanical power and producing more electricity. The heat generated becomes excessive, so you must find a way of producing less heat—or removing the heat. Armies of men will be required to lick this problem in plants throughout the country.

Kitchen ranges also are constantly under study to produce more compact ovens which will keep a uniform temperature without becoming too hot on the outside. Even such standard items as refrigerators are constantly under study to make them more compact and efficient.

Luke H. Noggle, manager of professional employment at Westinghouse, also notes that while his company continues to have an interest in people for purely analytical work, they are now looking only for people in this field with truly extraordinary talent. "Currently, we are more interested in men with an ability to solve customer-oriented problems. We need people who are willing to predict a probable payoff on the investment."

Deceptively, he said, while the largest graduating classes these days are in electrical engineering, the greatest demand is for mechanical engineers. "While of course we still require large numbers of electrical engineers, our need for mechanical men is greater now than in past years."

"Here at Westinghouse," he said, "we find our new people better trained technically than they were 10 years ago—but

(Please turn to page 48)

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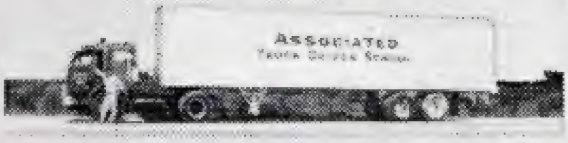

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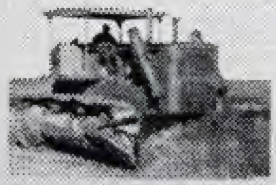

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today an engineer must be able to look through his technical environment and see its relationship to the world around him. Mathematics, physics and chemistry are basic, all right, but an engineer should also be able to design a machine that specifies reliable components, and will be acceptable to the people who will use it."

A spokesman for the Army in Washington agreed that these conclusions were generally correct, but felt that the armed forces were not less interested in research and development today, despite the heavy demand evidenced for standard equipment of war.

Noggle also gave some sound advice for young people preparing for technical careers: "Do a lot of thinking about yourself on your own account, and decide on the things *you really enjoy doing*, because these are the things you will do best and most profitably in the years to come. Reach a conclusion about yourself, by yourself. Do not go into a field simply because you have heard people tell you you should. No matter how well-intentioned, advice from family and friends can often be quite misleading. You know yourself better than they do.

"Finally, consider the possibility of going to an engineering-oriented technical institute of any approved kind, rather than a standard college. Technical institute graduates are going to be in great demand, because the nation will need first-class technicians in all fields, and the pay is usually excellent."

Boom in Mechanical Engineering

As indicated by the chart on page 44, demand for mechanical engineers is heavy. One recent month shows 1,055 jobs open for such men with a wide variety of specialties. In one of these, piping, there is currently a very heavy demand, so that men who usually get $4.50—$5.50 an hour, are up to $6.50 and $7 an hour in some cases. These jobs are in steam-electric stations. The pipes involved are heavy-duty ducts of very large diameters, often carrying expandable materials under very high pressure.

Due to a growing shortage of carpenters in the Chicago area, currently enjoying a boom in homebuilding, the Carpenters District Council recently started a training program designed to produce more better-trained apprentices, and make the trade more attractive to young men. Many older carpenters have left the Chicago area for Florida and California where the weather is milder and does not interrupt work as often. ★★★

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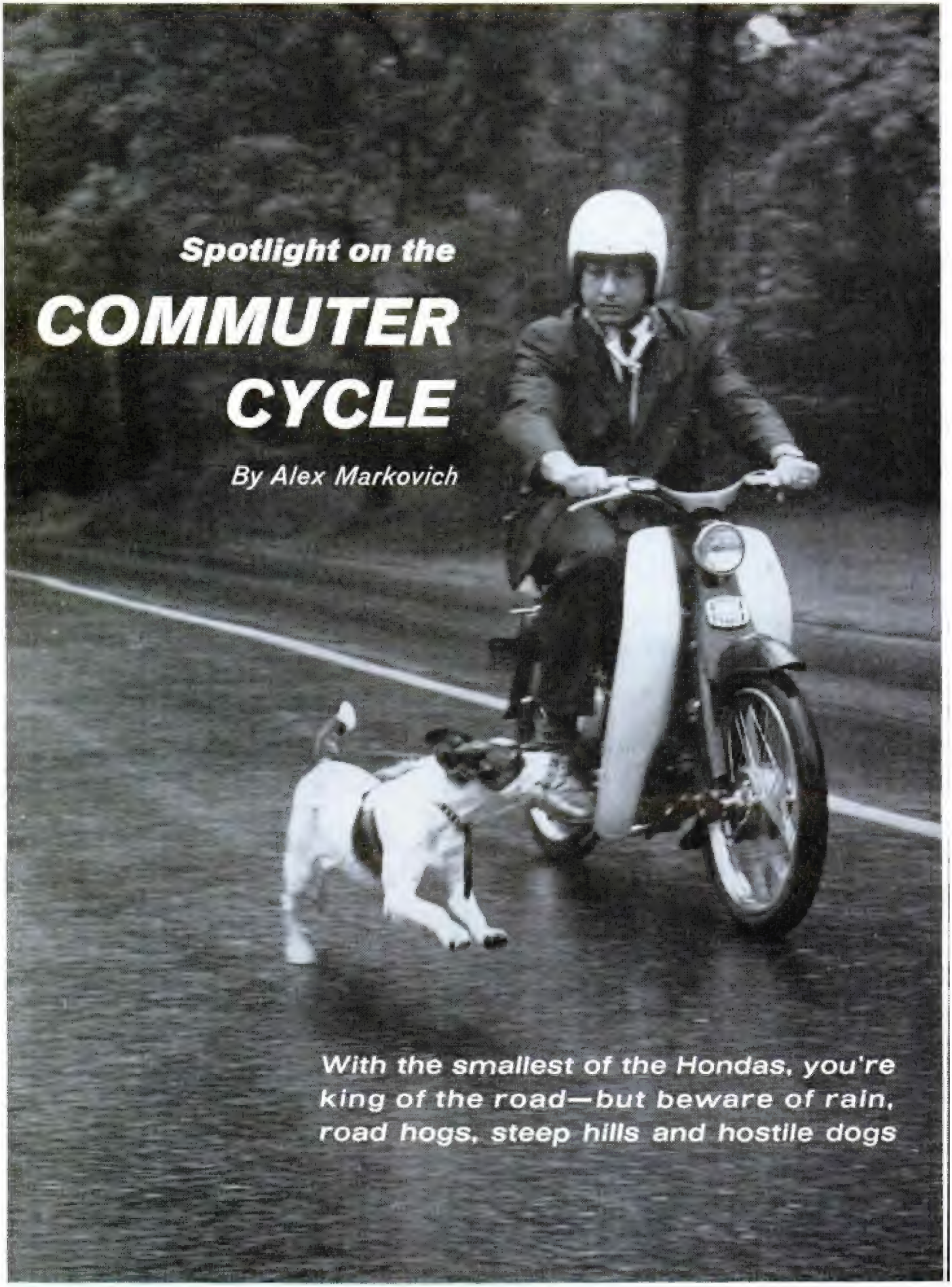

Spotlight on the

COMMUTER CYCLE

By Alex Markovich

With the smallest of the Hondas, you're king of the road—but beware of rain, road hogs, steep hills and hostile dogs

SMALL DOGS SOMEHOW LOOK BIGGER when there's no metal around you. Up steep hills, one dog-power is more than a match for small Honda's 4.5 hp

RAIN IS SOMETHING TO BE DREADED when two-wheeling. Forewarned by weather forecast, I brought along a folding raincoat, but my dignity was dampened. Leaning into corners is scary at first

SHIFTING IS A SNAP. Hit rear pedal (see finger) with heel and you're in first. Front pedal engages second and third. Rear pedal also controls downshifts. Black foot rest in middle is dead pedal

COMMUTING on a motorcycle is frought with unforeseen hazards—as I found out when I borrowed a 50-cc Honda for five days.

I'd never ridden a 'cycle. And picking one up in midtown Manhattan, 23 congested miles from suburbia, didn't seem like the best way to learn. To give myself a fighting chance that fateful Monday, I arrived at Honda of New York before 3:00 p.m. to miss the evening rush.

The first thing I noticed on the little black-and-white Japanese machine was scores of pedals and levers jutting out at all angles. I decided to confess to the salesman that I'd need a little instruction.

Thankfully, several of the pedals turned out to be dead footrests. The twist-grip throttle control for the tiny 4.5-hp engine is in the right handlebar. A pedal operated by the right toe actuates the rear-wheel brake, and a caliper on the right handlebar applies the front-wheel brake. I was warned to apply the rear brake first and then the front, in quick succession—to avoid undesirable gymnastics.

The left foot operates the three-speed gearbox via two little pedals. Heel the back pedal and you're in first. Toe the front pedal twice and you're in second. Another tap puts you in third. The rear pedal is used in downshifting. The clutch is an automatic centrifugal unit.

Finally, there's a foldaway starter crank on the right. (We had the $269 model; an electric starter costs $30 more.)

End of training. I fired 'er up and started rolling out the door, but the salesman stopped me with the wag of an index finger. That engine, he decided, needed a carburetor and valve adjustment. By the time they let me out, it was well after 4:00 o'clock and traffic was building up.

Somehow I lurched, dribbled and hopped the few blocks to the parkway. Accident ahead. It was stop-and-go for several miles. Half the time I couldn't find the brake pedal, so I used my feet to stop.

Finally traffic cleared, and I could roar along at 35 mph, the bike's cruising speed. Meanwhile, everyone else zipped by at 50. The 50-cc model will do 45, but this speed isn't recommended for long.

I was almost starting to feel confident—until the road went right and I went straight, across two lanes. In the 15 years since I was on a bicycle, I had forgotten how to turn. Miraculously, no cars were near.

By the time I reached the first toll booth, my hands were aching from gripping the handlebars so tightly. I began searching for change when suddenly the bike

(Please turn to page 52)

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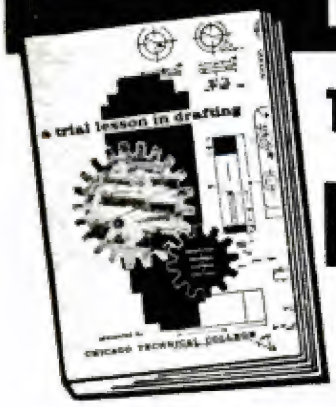

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Spotlight on the Honda

(Continued from page 51)

jumped. Omigosh, what did I do wrong now? Then I heard the driver of the car behind me apologize for clobbering me. I checked the rear fender; not even a nick. That Honda is built like a brick house.

The rest of my trip on the parkway was relatively uneventful, except for a dusty stretch under construction. I got enough dirt in my eyes to start a victory garden, so I made a mental note to buy goggles.

Just before home there's a steep hill. Even after a downshift, my speed dropped down to about 15 mph. All at once, there was a noisy blur of spotted white heading for the meaty part of my leg. That little neighborhood mutt was outrunning me! Only one thing to do. Bark back.

It was only after I reached my driveway that I realized how stiff my muscles felt.

Tuesday morning I got up extra early. The bike started easily from cold, but stalling was a problem. The solution was to ride away without warming up. Within a mile or so the stalling stopped.

I practiced at a nearby parking lot, and within minutes I was able to use body lean to steer pretty much where I wanted to go. But when shifting, I still had to think twice whether to heel or toe.

Dogs—All Kinds

Finally I started off to work. I still didn't trust myself in Manhattan traffic, so I rode to my in-laws' house in the Bronx, left the bike in their back yard and subwayed into Manhattan. The trip home that afternoon was uneventful except for a mild incline on the 50-mph-limit parkway, which caused my speed to drop to 20; there was much fist-waving from passing motorists. Oh yes, and I had another strained encounter with the dog.

By Wednesday I was starting to relax. Shifting, braking, steering, all had become fairly natural actions. I began to enjoy the scenery, to see the many things I had missed while driving a car. I felt a delightful freedom as the throaty *bra-a-ak* of the little high-revving engine filled the air around me. Once again I left the bike in my in-laws' back yard.

Before I left the office that afternoon, my wife phoned to tell me to bring home bread. Fine. I reached our local market without any problems and bought the bread. Then it hit me. No luggage rack. No basket. I had to hold the bag in my teeth. Luckily, the dog didn't chase me that day; I couldn't have barked back.

Thursday I got up enough courage to try for Manhattan. South of the Bronx, traffic really got constipated. Up to that

SOLVING THE PARKING PROBLEM is easy with a bike. Just bring it up into your office in the freight elevator—as long as you have an understanding boss. Fellow employees will want to try it out

point. I had stayed smack in the middle of the right-hand lane on parkways, but now cars kept squeezing into my lane. The only answer was to stay to the left of the lane and be ready to stop quickly.

I pulled into a garage near my office and asked the rate for a bike. "Three twenty-five," the attendant said.

"Why, that's what you charge for a car," I said indignantly.

"If it's got wheels, that's the price," he answered gruffly. "You can come in on roller skates and it'll still cost you $3.25."

"Each?" I snapped, and roared out.

The next two garages didn't want any part of a motorcycle. "Don't have room for 'em," one attendant said.

Finally I found a garage that would take the bike for $1 instead of the $3 car rate.

On the way home it rained. A folding plastic raincoat didn't help much.

By Friday I felt like a pro as I weaved and darted through traffic. By the time I reached Manhattan, I got an idea: Instead of leaving the bike in a garage, why not bring it up into my office? The bike fit in the freight elevator perfectly. People stared and pointed, but no one stopped me.

Just after 9:00 A.M. the executive editor called me into his office *on the double* for a conference. You guessed what happened next. Did you ever hear an engine revving 9500 rpm down an office corridor?

It's now Friday afternoon. I just returned the Honda to the dealer, and I feel strangely let down. I know now that some day I must own a Honda—though I'd like a bigger model, with a little more speed than the 50-cc offers. I mentioned this to my wife and she said we can't afford one. But maybe if the kids could drink a little less milk every day and . . .

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Inventors peddle

THE WILDEST SHOW of the season whirled into New York City's Coliseum like a fresh March breeze recently. Popeyed spectators gaped at things such as smog filters that clip to people's noses; shrinkable films that form skintight gloves on human hands—or on anything; pot-side egg-timers that flip eggs from the water when done; a submarine that comes out of the sea and flies like an airplane.

Gawkers watched moving belts that stole eggs from beneath frustrated hens. It dropped them, bobbling, through sorters and counters that tallied each grade size—and even put the finger on goof-off cacklers who weren't firing enough product into the line.

What brought all this on? A giant clam-

ROLL-OUT PLATFORM for station wagons slides the whole load back over the tailgate and simplifies loading and unloading. It was invented by Faliero Gelli to ease the problems of his catering service to offices, shops and factories

CHAIR CONVERTS TO A CRIB or youthbed for a youngster's overnight visits. Don Milne dreamed it up for grandparents living in small quarters, where a permanent crib would be in the way. He hopes that hotels will like it, too

their wares

By M. J. Pederson

bake known as the International Inventors and New Products Exhibition. It involved some 200 starry-eyed inventors and a similar number of visionary manufacturers—all combing the crowds for likely looking "angels" who might back their brainchildren. Several foreign countries and all 50 states were represented, according to our information from a spokesman for the International Institute of Patented Products, Ltd., sponsors of the show.

HAIR CUTTING GUIDE is used with brush attachment and vacuum cleaner hose which sucks hair out through ribs of crown-shaped guide. It insures an even haircut

DOWN-AT-THE-HEEL PREVENTER is a cleverly designed affair which, when worn in one place, can be given new life by rotating a section to an unworn spot

Modeled after the annual Brussels Fair, the exhibition provided display space (at a basic rental fee of $108 per booth) for new ideas from everywhere. A few "Rube Goldbergs" seemed bent on complicating life as much as possible. But most creations were designed to simplify matters. There was an automatic 15-day fish-feeder, and a typewriter margin indicator to eliminate the frustration of unwittingly typing to the bottom of the page. There was a novel method for playing the piano, too. The music score consisted of a visual reproduction of the keyboard, plus an intricate system of symbols and words (names of colors) to replace old-fashioned notes. To me—a dyed-in-the-wool note-reader—the system seemed impossibly cumbersome, at least for the uninitiated.

The most interesting aspect of the show, especially to non-trade visitors, was the inventors themselves. For the most part they were ordinary, sensible people who, recognizing a need for something, had solved the problem with a workable device and had seen their idea through to a patent. Here, in the American tradition, they hoped to capitalize on their brainstorms.

Most exhibits, consequently, represented frustrations turned into marketable products. A good example is Don Milne's crib which, when not in use as such, converts into a chair, coffee table or combination desk-bench. As grandparents of a little boy who made frequent overnight visits, the Milnes found it troublesome to be without a crib, but did not want one cluttering up the place when not in use. So their convertible crib was born. They hope it will become standard equipment in homes of retired folks, where space is at a premium, as well as in hotels and motels.

Another exhibitor who provided a convenience for others, by virtue of solving a problem of his own, is Faliero Gelli. He invented a highly practical roll-out platform for station wagons.

Gelli was a pilot in the Italian Air Force during World War II. Shot down by the British over Malta, he was shipped to England as a prisoner, then to the U.S. Upon release after the war, he made the United States his home and eventually set himself up in a unique catering business

(Please turn to page 56)

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Inventors peddle their wares

(Continued from page 55)

BARBERSHOP LUXURY may be had in the home with this hot lather dispenser that plugs into any outlet. Available soon at local drugstores and gift shops

PLEATED DRAPERIES require no sewing. They're made by folding fabric around sandpaper guide, then fastening pleat with a paper clip and lady's hairpin

in Irvington, N. Y. His "restaurant" was a station wagon, loaded up with an assortment of sandwiches, cakes and beverages. His customers worked in local offices, shops and factories. His annoyance, each time he loaded or unloaded his wares, or spilled hot coffee while trying to reach the innermost items, supplied the motivation for his roll-out platform—a false bottom that slides out over the tailgate and brings everything on it within easy reach. It's a "natural" for station wagon vacationers.

The youngest occupant of a booth, following in his father's footsteps, was six-year-old Andrew Sobel. He's the inventor of a telescoping fishing rod that is small enough to fit into a briefcase or schoolbag. It should be just the thing for hooky-

FILTER OF BLOTTER TYPE PAPER and cotton fibres inserted in cigarette shows tar and nicotine stain left after smoking. Liquid absorbent paper is key

players, including traveling salesmen who like to fish on the boss's time.

Andy's father, an emigrant from Poland and holder of several U.S. patents, was not to be outdone by his progeny. He has a few ideas of his own available for licensing; one is a method enabling a man to wear his trousers with or without cuffs, depending on his whim or the occasion.

For people who want to make pleated draperies, but can't sew and don't want to learn, there is now a way out. They need only fold the fabric around a sandpaper guide, and then fasten the pleat with a paper clip and a lady's hairpin. That's all it takes. Abe Levine of Brooklyn, N. Y., is the inventor.

In a lighter vein, the Stephen Barratt Co. has created a frightening golf ball that should awaken the sleepiest early-morning foursome. They'll see a trail of colored smoke stream from the ball as it soars down the fairway. Chemicals stored inside the ball are released through small holes when it is driven from the tee.

SECOND-GRADER Andy Sobel extends telescoping fishing rod he invented. It fits in a case the size of a pingpong paddle

As the hectic five-day show drew to a close, it was evident from some jubilant expressions that many a dream might be on the verge of realization. Others, dejected by the activity in neighboring booths, appeared resigned to packing up—mission unaccomplished, this time. Regardless of the outcome, most exhibitors will turn their thoughts to "next time" and the promise of the sign on the Coliseum marquee which reads: "One idea can change your future."

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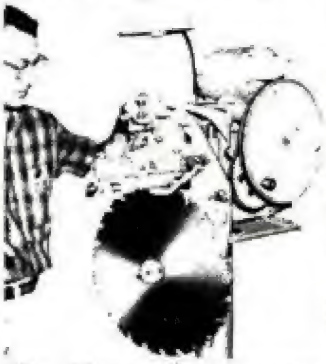

Hundreds of people like yourself are making cash like this—$20 to $30 a week—right now in spare time. "My spare time saw filing business has made me $952 these first ten months"—says R. T. Chapman. Many have built a complete sharpening service with year-around profits. You can, too, simply by following, the sure, easy Foley plan.

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Husband and Wife Have Going Business

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DETROIT LISTENING POST

BY JIM DUNNE

Here comes the front-drive Merc

Mercury has been selected by the Ford Motor Co. as its front-wheel-drive car. A front-drive system, now in test cars, will be made available through the Mercury line two years from now. The front-drive system will be standard equipment, available on station wagons as well as sedans and convertibles. This is the first firm reaction by a competitor to Olds' front-drive Toronado.

Olds is also prepared to make its front drive available on the rest of its car lines. An Olds official told us over a year ago that the system would spread to other Olds models if it was successful in the Toronado.

What's new in engines

GM car divisions have been forbidden by the front office to put any engine bigger than 400 cu. in. into small cars. One exception is the Corvette, considered a special case. The rule has led to some strange engine shuffling in the divisions. Chevrolet can use the 396 cu. in. engine in its Chevelle but not the 427, even though both are nearly identical in every other respect. Buick's 401 cu. in. power-plant suddenly became a 400 cu. in. size when used in the Skylark. Same engine, different accessories. Oldsmobile performed a minimum of changes on its standard 425 cu. in. engine to drop displacement to 400; offers it as a top power option on the F-85.

Chrysler Turbine engineers no longer expect a dramatic breakthrough in turbine engine development. So they have been busy just refining the present turbine design. Right now the turbine can match a modern gas V8 in both performance and fuel economy. Major roadblocks to its mass production are the high cost of turbine wheel materials and the huge investment necessary to build up a service system.

Mustang will get a major facelift next year. The sporty Ford will receive more styling attention when the 66s come out because of the expected competition from Chevrolet's new small car (Panther?). The fastback Mustang will have a racing car look. Its roofline will extend clear back to the rear bumper, and the rear end will have the bobtailed styling of Ford's GT race car. New sheet metal and a new grille design will be used to freshen up the front end appearance.

Chrysler goes sporty; Mustang sportier

Ford's success with the Mustang will prompt Chrysler to bring out a similar car within the next two years. Chrysler officials say privately that the company will have a new car in the line-up soon. Right now Plymouth's Barracuda is not enough competition for the Mustang, and company officials say a complete new line of cars is the only answer.

Modern sex appeal for the Rolls

Rolls Royce is en route with a completely new car. It will be lower, wider, sport a modern appearance. It should be out within a year. It will compete with American styling for the first time. Price remains about $20,000.

Shift to automatics

Are 4-speed transmissions overrated for performance driving? "Yes," say some Detroit engineers. Automatics have proved conclusively faster on the drag strip, and now they are being used in road races with some success. Pontiac engineers say they have a number of automatic transmissions on the shelf that will outperform a 4-speed almost every time. The Chrysler Corp., thanks to its automatics, has revolutionized stock car drag racing, cutting short the revival of 4-speeds in that competition. Still, the 4-speed box, with its high price tag, continues to be a big seller. All indications are that sales of 4-speed boxes will increase

(Please turn to page 60)

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LISTENING POST continued

over the present 400,000 annual rate. How about you? Do you have a special reason for liking the 4-speed? France's Renault car company has a good sales gimmick. Renault sent out 33 panel trucks equipped with light repair parts and tools to aid stranded motorists. The trucks cruised French highways during this past summer and fall. It started as an advertising stunt, and proved so successful that other auto makers on the continent are reported ready to try the same thing next summer. The trucks will service any motorist free of charge as long as the trouble can be cleared up within 15 minutes. Problems with fuel, oil, water, tires, fan belt, or similar small items were worked on regardless of make.

STP Specials for Indy

Carroll Shelby, the Cobra builder, may be in next year's 500-mile race at Indianapolis. Shelby reportedly has been lining up a car with European-made chassis and Ford power. Jim Hall, Shelby's opposite number with Chevrolet, is also reported interested in the race. Look for the STP Specials, the only 4-wheel drive design of recent years, to be back in Indianapolis next May. And don't count out the Offenhauser engine yet. The Drake half of the Meyer-Drake partnership that sells the Offy is developing a lighter, more powerful engine to stay competitive with the Fords.

Cars are getting cooler

Car airconditioning, once considered a rare luxury, continues to boom in popularity. Lincoln is selling over 90 percent of its cars with the cool option, the first time any car has exceeded that figure. More than 78 percent of Lincoln convertibles are delivered with A/C! Cadillac, with the most simplified controls, installs its Comfort Control system on 83 percent of its cars. Even Rambler, with the so-called "economy car image" delivers more than one of every ten of its cars with air-conditioning. In two years all makers will have one temperature control lever like Cadillac's, making the option even more enticing.

Turn with a twist is in

Mercury will produce more cars with its "wrist-twist" steering system this year, but they will be used for test purposes only. (Wrist-twist replaces the steering wheel with two small steering rings mounted on the ends of a crossbar fitted to the top of the steering column.) The newer wrist-twist units will have variable ratio systems. Wrist-twist is not ready for mass production this year, according to Mercury. Confidentially, though, you'll be able to buy the system later in 1966. Cost will be about $100 more than power steering. . . . Ford's overhead-cam engine is not generally available to the public, despite what Ford says. You have to be in the race business to get one. But the company may be forced to loosen up its sales of this engine to keep up with the strong competition from Chrysler's Hemi and Chevy's new 427.

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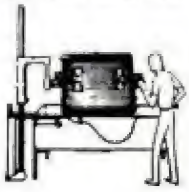

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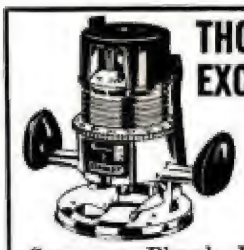

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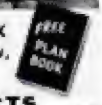

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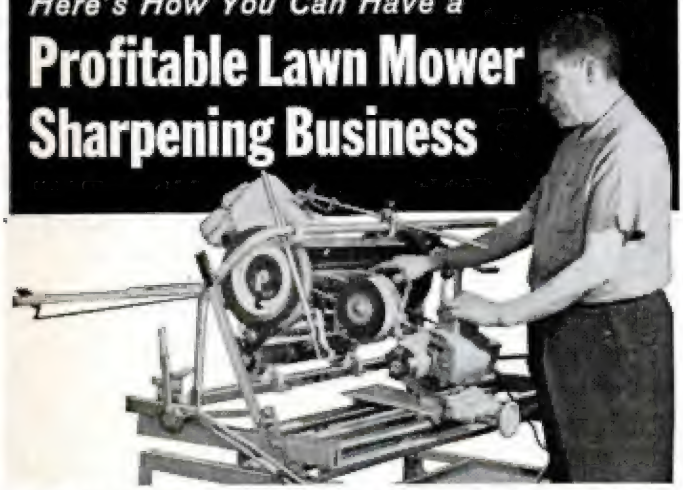

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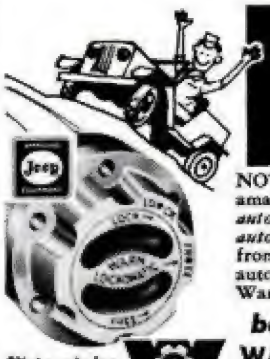

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SELL Uncle Sam! Depression proof home business buying Old Gold. Successful plan shows how. Details free. Patton, Dept. PM-115, Box 283, Arlington Heights, Illinois.

MANY Earn $1500.00 per month operating collection agency. Free details. Franklin Credit, Roanoke, Virginia 24004.

LIQUID Molding rubber, free information, Chaney's, 5415-A San Jose Blvd., Jacksonville 7, Fla.

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EARN Money evenings, copying and duplicating comic cartoons for advertisers. Adservice, Argyle-1, Wisconsin.

CIGARETTES. Make 20 plain or filter-tip for 9¢. Factory-fresh pipe tobaccos. Mild tropical flavored Philippine cigars. Facts free. Moberly, Box 904, Owensboro, Kentucky.

SELL Titania gems: more brilliant than diamonds. Catalog 10¢. Diamonite, 2420-G 77th, Oakland 5, California.

EARN $240.00 a month at home, spare time, doing only two $5.00 invisible mending jobs a day. Big money paid for service that makes cuts, tears disappear from fabrics. Steady demand. Details free. Fabricon, 1532 Howard, Chicago 26, Ill.

MINK Raising information free. Lake Superior Mink Farm Inc., Superior, EE1, Wisconsin.

BIG Money raising fishworms and crickets. Free literature. Carter Hatchery, Plains, Georgia.

NEW Instant invisible mending. Learn in one hour, repair in five minutes. Make $150.00 week. Literature free. The Henson Company, P.O. Box 6136-6, Philadelphia, Pa. 19115.

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AMAZING Successes through franchises! Become exclusive franchise holder your territory. Information rushed. National Franchise Reports, WP-528, 333 North Michigan, Chicago 1.

MAKE Plastic novelties for extra income. Low cost home training now available. Write for free booklet. Interstate Training Service, Dept. D-3, Portland 12, Oregon.

WORK Home, part-time, mailing our catalogs! Free details! Cam Company, Dept. 53, Verona, N.J. 07044.

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MAKE Money reading your newspaper! LIU-PM2, Box 4759, Chicago 60680.

SHARP $$$$ Opportunity! One low-cost machine sharpens—serrates knives, scissors pinking shears. Earn $6-$9 hourly in spare time. Professional results without experience. Free details. Beaver Machine, Box 121, Gardena, California.

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EARN Thousands yearly, selling books by mail! Romain House, 1810-PM, Romain, Columbia, South Carolina 29210.

FABULOUS Profits raising fishworms. Guaranteed market. Free picture folder. Excello, Kosciusko, Mississippi 39090.

FREE Literature! Planned profits, all ages. Postal okay: Aladdin Research, Box 5183-K, Oakland, California 94605.

BIG Profits selling books by mail. No inventory necessary. Free details. Laurins, 1137 Second Avenue North, Jacksonville Beach, Florida 32050.

CASH In on prize contests. Learn how. $1.00. Laurins, 1137 Second Avenue North, Jacksonville Beach, Florida 32050.

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"NEW BOOKS", 80 ways to make extra money by mail. Lee, Box 252-P, Goleta, California.

LEARN The secrets of repairing junk batteries. "Fabulous Profits" at home. Details. The Batteryman, P.O. Box 416, Palm Desert, Calif.

MAKE Money with coins, operate by mail from home. Informative pamphlet, $1. J. Taylor, 3516 Kensington, Evansville, Indiana.

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TYPISTS! Typists! Typists! Work home. Steady income. Hamilton, Box 4, Astoria 5, N.Y.

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80 WAYS To make money by mail. $1.00. Box 14368, Okla. City, Okla.

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EXCLUSIVE 77 page guide. Build profitable mailorder business. Buchwalter Sales, 834—175th St., Dept. 12, Hammond, Indiana 46324.

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BOOKS, Folios, for homeworkers, hobbyists, writers. Ralph Underhill, Beebe, Arkansas 72012.

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Wheelbase	**119"**
Overall length	**211"**
Overall width	**78.5"**
Overall height	**52.8"**
Curb weight	**4496 lbs.**

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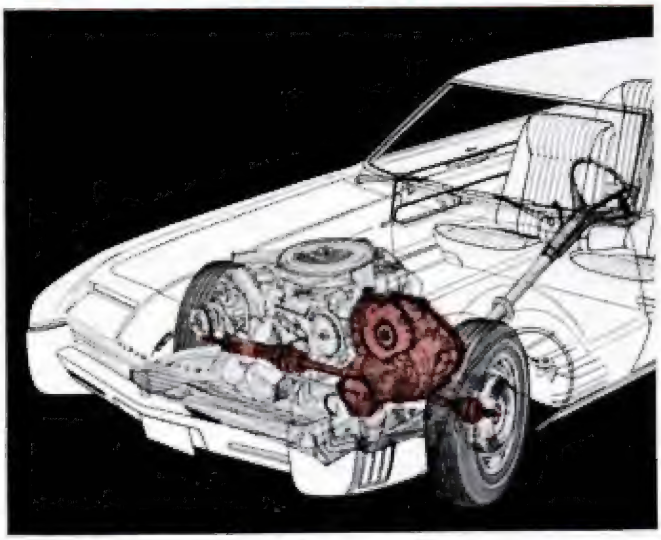

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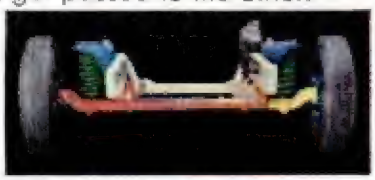

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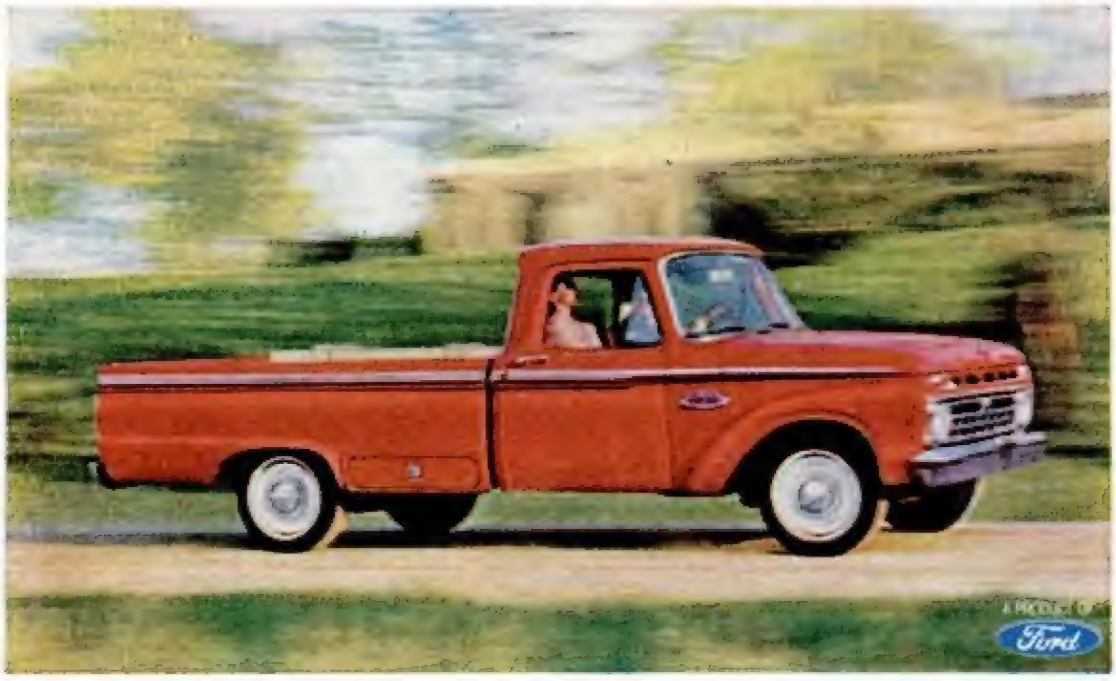
Come on in and check us out. Action-test a new Ford today.

FORD/66



EDITOR'S PAGE

New faces on the PM staff

If you've noticed a little tidying up of *Popular Mechanics'* appearance, the broom was wielded by **Raymond A. Schulze,** our new art director. Ray came to us from Hayden Publishing Co., where he also wielded an effective broom. His work has brought him a N.Y. Photo Engraver's design award and plaudits for his revamping of a whole string of magazines: Media/scope, Electronic Design, Electronic Week, Electronic Daily. He is 31 years old, lives in New York, schooled at Cooper Union. "Graphics are the means to an end," he says. "The key to ease of communications." That's his goal at *PM*. . . . Our automotive editors have had a tough time explaining to their wives why they were running back and forth to Detroit like tired commuters. Our new Detroit auto editor, **James Dunne,** will make the ladies happier—and us, too. He's an old hand in the auto center's "backstage," where he dug up inside stories for Automotive Industries magazine as its midwest editor. Jim is known in the field as a solid "insider," has produced an impressive array of stories on new-car testing, manufacture and development. He's 34, a graduate of Detroit U., is married and an Army veteran. He's a fast-moving traveler. You'll see some samples soon. . . . Staying on top of developments in the home-building field is a king-size job. **Richard L. Howe,** 37, is the new building and housing editor who will do it for us. Dick comes to us with ten years' background in our own field as a topflight "how-to" editor. Before that, he rewrote essays for Nobel Prize-winning scientists, so **people** could understand them. He attended Western Reserve University, then satisfied a wanderlust in the maritime service. Nowadays, as he puts it, he "shares three children, a dog, a cat and a turtle" with his wife—in a Nyack home.

THE MISSING LINK IN TRANSPORTATION

It's ridiculous to put a bulky passenger car on the road just to carry one person, contends this designer. His goal: Build a practical small car

By Jay Doblin

PM'S OWN SUBURBA-CAR is one way of providing that "missing link" in transportation. Two of the author's students at the Illinois Institute of Technology designed the chassis, using a Honda motorcycle engine for power. The author then created this model as a possible body design. If you have other notions about the way it should look, see page 88 for instructions on entering PM's Suburba-Car design contest

KENNEDY EXPRESSWAY, Chicago's major suburban artery, has a rush-hour name. It is called, by the natives who use it, "America's longest parking lot."

This is a pretty state of affairs—especially in the Land of Lincoln where loyalty to accomplishments and "things" usually is so intense that it borders on intramural nationalism.

Yet the sarcasm directed at this new giant expressway, leaping across the swarming midwestern megalopolis with seven-league strides, reflects a burgeoning problem in nearly every major American city. It is the price we are paying for the four-wheeled dinosaur (often two or three) in every garage. Each new car model year, instead of solving the problem, complicates it as cars grow longer, wider, more powerful and unwieldly.

At present, the average car needs about 300 square feet of space—whereas the average person uses less than 100 square feet for any given activity (shopping or dining, for example). This means that three times as much precious space must be provided for parking and roads as for the activity that leads a driver onto the highways in the first place.

Aerial views of Los Angeles reveal that no less than 70 percent of the city area has been devoted to streets and parking.

Now, you are guessing that I am about to make the dire forecast that the king-size luxury car is doomed. Not so. There is a place for the family bus—and, indeed, a real need for it. But it is also becoming perfectly clear that we must have smaller cars.

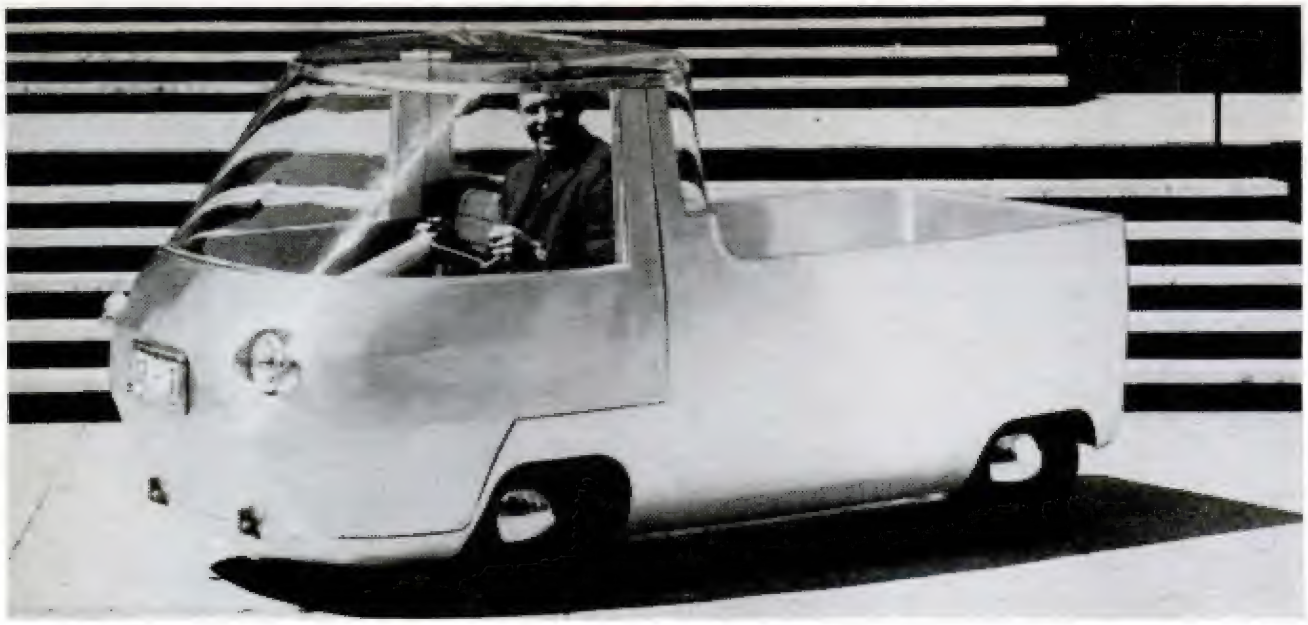
There are three factors forcing us in this direction. The first is our trend to urbanization; population density continu-

***ABOUT THE AUTHOR:** Jay Doblin was director of the Institute of Design, Illinois Institute of Technology, from 1955 to 1964, is now a professor there. He graduated with honors from Pratt Institute in 1942, was with Raymond Loewy Associates from 1942 to 1955*

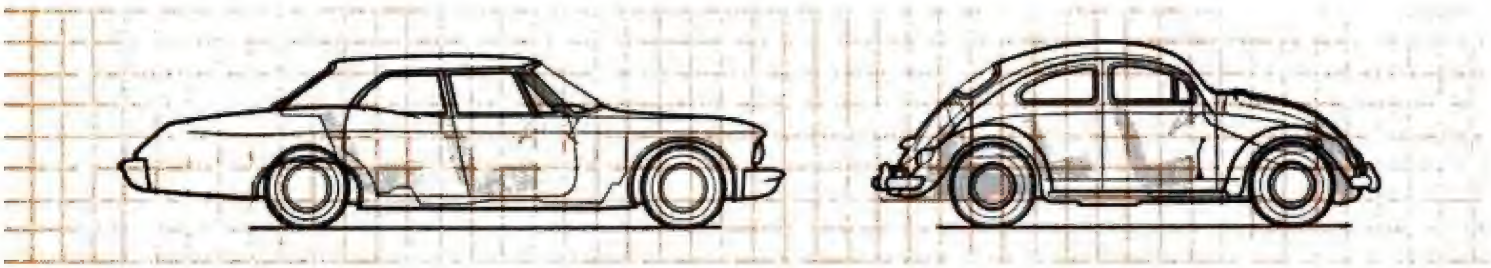
ABOUT AS TINY as an enclosed vehicle can be, this three-wheeler carries one person. All vehicles shown here were designed by students at the Illinois Institute of Technology in Chicago

POWER CHAIR, propelled by 4½-hp four-cycle engine, was designed to be driven to station, transported by rapid-transit train, then driven to office. It occupies 15 square feet of space

FOUR-PASSENGER AUTO is powered by two-cylinder Toyota engine with front-wheel drive. Rear passengers face back and enter through rear door. It's almost two feet shorter than a VW



SPARKY is an electrically powered urban runabout. It can go 30 mph—and 60 miles on a charge. There are only three controls: an aircraft-type steering yoke, accelerator and brake. The rear deck can carry 800 pounds



STUDENT'S EFFORTS have been concentrated on designing small vehicles that will take up little space but will still serve as adequate personal transportation. Relationship of one student design to current automobiles is illustrated in graph. At left is a 17¾-foot-long 1965 Chevrolet. In the center is the 13½-

ally goes up. Second, there are more cars per capita. Over the last 30 years we have progressed from one-car families to two-car families, and there are now many three-car families. We are fast approaching the time when there may be one automobile for every adult. Third, there's the rapid increase in population.

All this indicates the need for smaller cars as an interim remedy to prevent the breakdown of urban traffic.

There's just too great a gap between the pedestrian and today's automobile. Americans seem to regard anything beyond three-eighths of a mile as too far to walk, so they hop in the family juggernaut when the urge to be somewhere else hits them. (And it's ridiculous to see a 4000-pound, 300-hp vehicle moving a 100-pound housewife and a bag of groceries at 25 mph.)

Some of the sleekest small vehicles I've seen are those designed by students at the Institute of Design of Illinois Institute of Technology.

One student, Louis Richards, attempting to determine how tiny a personal vehicle could be—how to "motorize a pedestrian," as he put it—built the Skeeter several years back (see photo, page 87). In fact, he built four of the vehicles, which rather resemble the currently popular motorized skateboards.

The various Skeeters ranged from a 12-pound vehicle with a model airplane engine that could propel a man 12 mph to an 18-pound machine with a half-hp engine that would zip along at 20 mph.

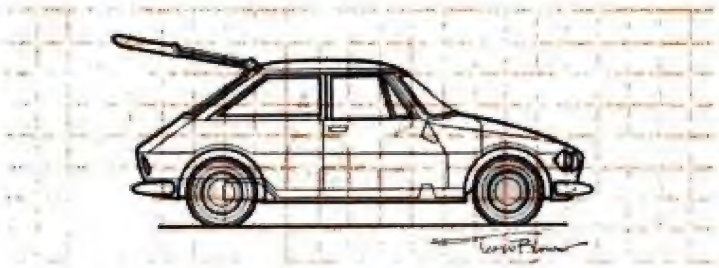
Another student, Makato Kamegawa, built a four-passenger car nearly two feet shorter than the familiar Volkswagen. The car is powered by a two-cylinder Toyota engine and has front-wheel drive.

The two passengers in the rear enter through a rear door and seat facing backwards. The rear seat folds up so that the back of the car can be used to carry freight.

Two other students designed the chassis

SPARKY'S CAB opens like a clamshell for walk-in entry. Rear deck has fold-down seat for extra passengers. The entire vehicle weighs 1000 pounds

SKEETER is a study in how tiny a personal vehicle can be. Steered by leaning, it's powered by a half-hp industrial engine. Top speed is 20 mph. Handle of the 18-pound machine folds down for carrying



foot-long Volkswagen 1200. And at right is a 12-foot car designed by a student at the Institute of Design (also shown in the photo at bottom of page 85)

for the Suburba-Car, a neat little three-wheeler that's great for buzzing off to the store for groceries or for a commuter's lift to the station. The designers, Alan Flowers and Brian Skogler, powered the car with a Honda motorcycle engine that takes it up to 60 mph.

As for the body of this car, there are dozens of ways to complete it. You can try a version and enter it in *PM*'s body design contest (page 88). I completed one version in miniature (page 84) that illustrates how the Suburba-Car could be made into a sort of miniature station wagon with a tailgate for loading groceries.

These small vehicles can be divided—rather simply—into two groups: those with weather protection and those without.

Those without protection have the virtue of being simple and inexpensive, but in the United States you might just as well suggest riding a horse. Bicycles, scooters

(Please turn to page 254)

CHARIOT steers by a handlebar that rotates 360 degrees, giving reverse without gear change. The small vehicle is capable of 25 mph speeds and can be driven on rough surfaces because of large wheels

DESIGN A BODY FOR THE

Win This

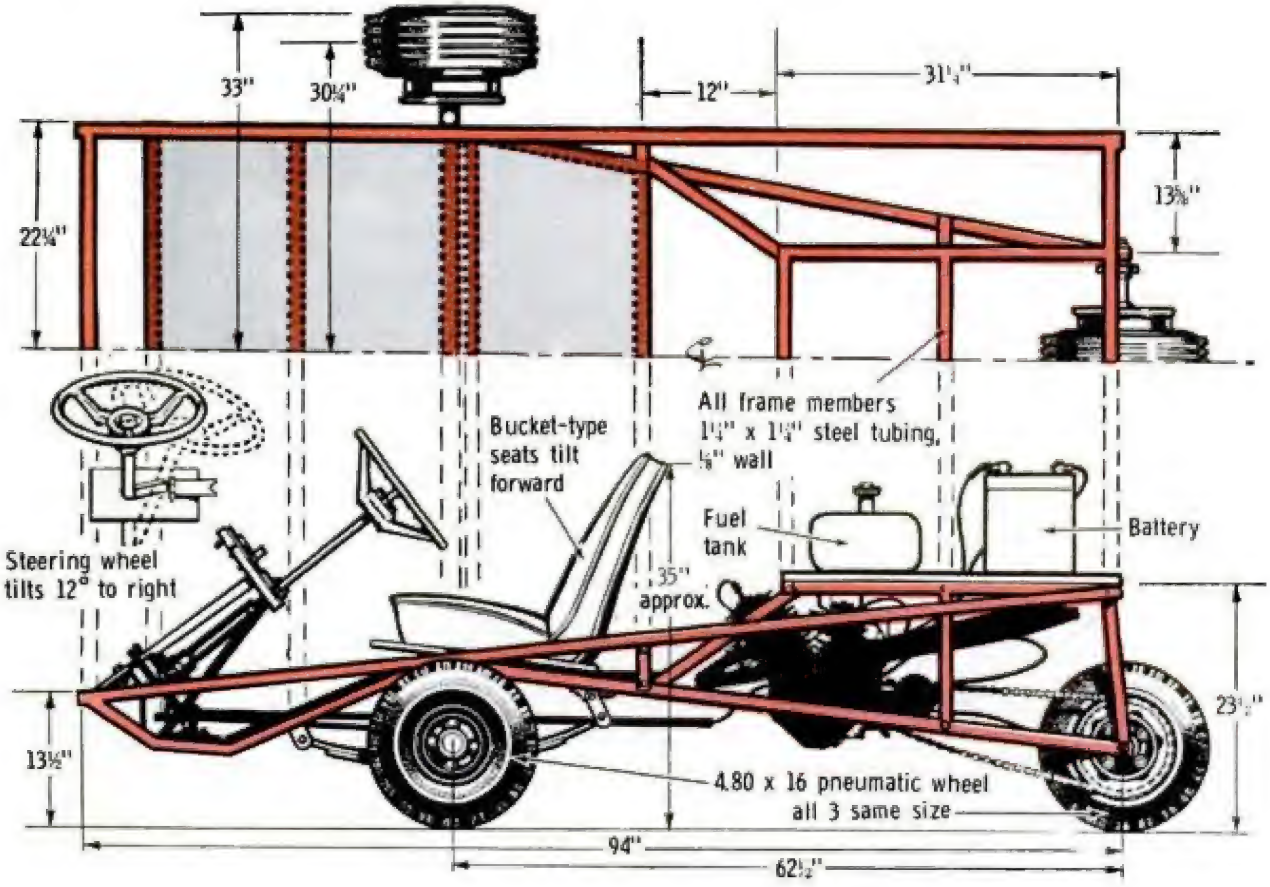
HOW would you like to be the lucky guy to own this one-of-a-kind Suburban Car? You'll find it the hottest thing on three wheels for scooting about the neighborhood. Your wife can use it for picking up groceries, running errands, carting the youngster to school. And you could be the envy of fellow commuters in breezing up to catch the 8:05.

Equipped with a fine Honda engine, this sporty two-seater will stretch a gallon of gas like a rubber band, and it can dart in and out of parking spots like a rabbit.

How do you win it? Simple—you design a body for it and submit your design to *PM* Suburba-Car Contest, 575 Lexington Ave., New York, N. Y. 10022, postmarked no later than Dec. 20, 1965. There's nothing to buy; nothing to build. If judges select your design as best, the powered chassis shown at right and on the cover, will be shipped to you lock, stock and barrel, just as it appears in the photo (minus briefcase and umbrella). Then you can add your own prize-winning body and sport the coolest puddlejumper in town.

You need not be an artist or designer to win. The quality of the drawings you enter will *not* be a factor in the judging. Your entry, however, must be shown in drawings to a scale of 1 inch equals 1 foot. The drawings must include a side, front, rear and top view of the body you design, fitted to the dimensions of the chassis shown below. The materials you plan to use must be indicated on the drawings, and you should label any special features.

You may also attach a written description of your Suburba-Car body and may submit a model, if you wish, to help the judges interpret your design. However, such additional material is not essential. *Only the design itself will be considered in the judging.*



PM SUBURBA-CAR AND

Chassis!

Entries will be judged as follows:

1 **Appearance.** Your Suburba-Car should draw admiring attention wherever it goes. You may give it sleek sports-car lines, or the conservative lines of a small family car. You may want to make it look like a beetle, a bus or a teardrop. In any case, the lines must be pleasing to the eye. Your design may soon be parked in *your* driveway and you'll want to be proud to have it there.

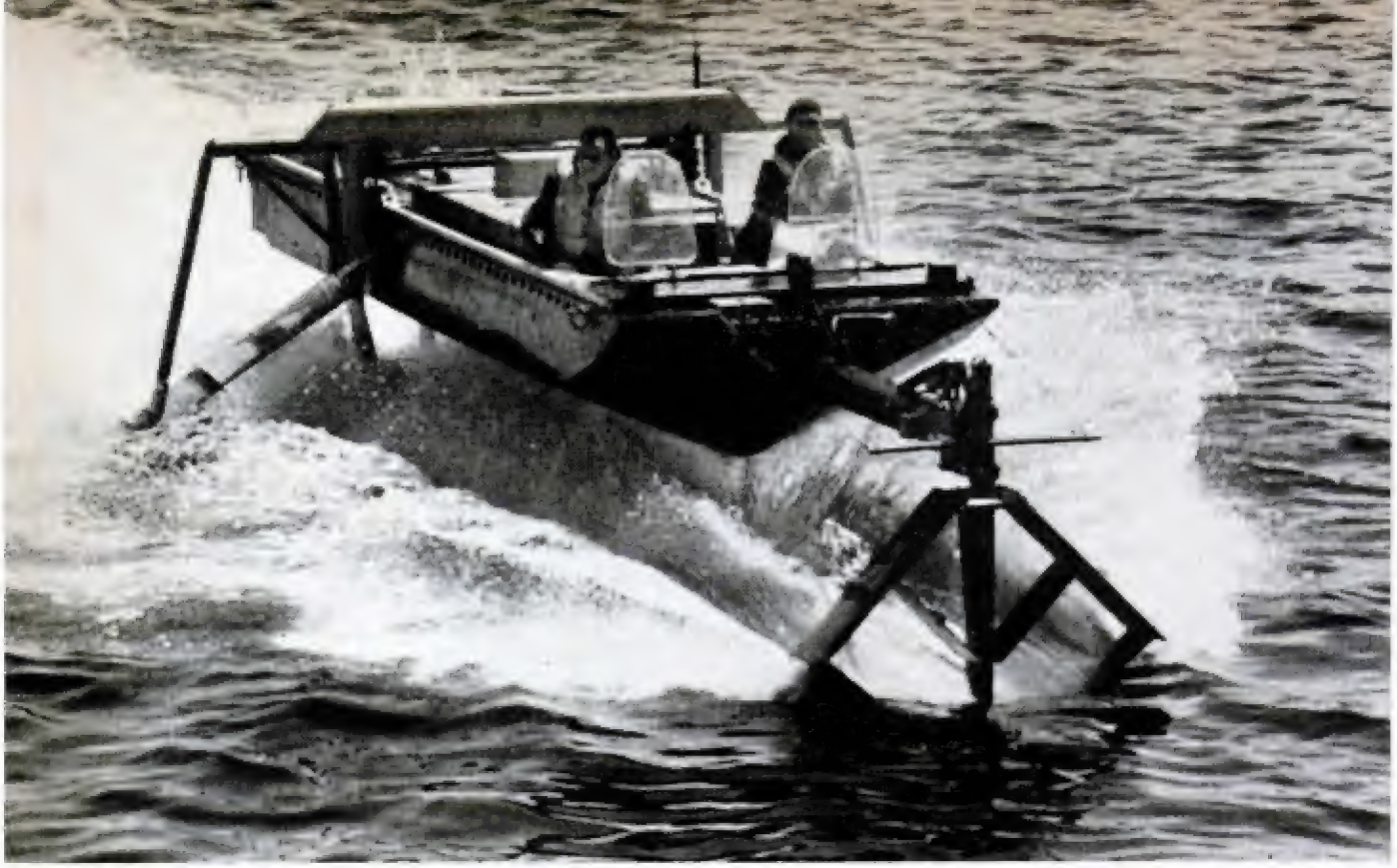
2 **Utility.** The chassis has been designed, in overall size, to carry two persons and two large bags of groceries. Does your body design take full advantage of this chassis space? Have you provided easy access to the storage compartment such as the body provides on the vehicle shown on page 84? Are your doors of adequate size, and so placed that members of your family won't have to be contortionists to get in and out of your dream Suburba-Car?

3 **Ease of construction.** If you win, remember you'll be building your winning design yourself. So the materials you specify should be readily available and adaptable to your design. Where compound curves are involved, you may wish to suggest Plyfoam as a material, after reading our exclusive report on page 146. *But you are not limited to any one material.* The judges also will consider whether your entry can be built with the tools (including power tools) that can be found in a well-equipped home workshop, so don't plan on using a commercial shop.

4 **Safety.** In most states a car must have the following equipment as a minimum: safety-glass windshield, taillights, headlights, brake lights, turn signals and wipers. Don't overlook them. They can be found in most auto-supply stores and may be specified in your design.

5 **Economy.** No limit is set on cost of building your design. But, judges will take into consideration the estimated cost of your completed Suburba-Car in

(Please turn to page 242)

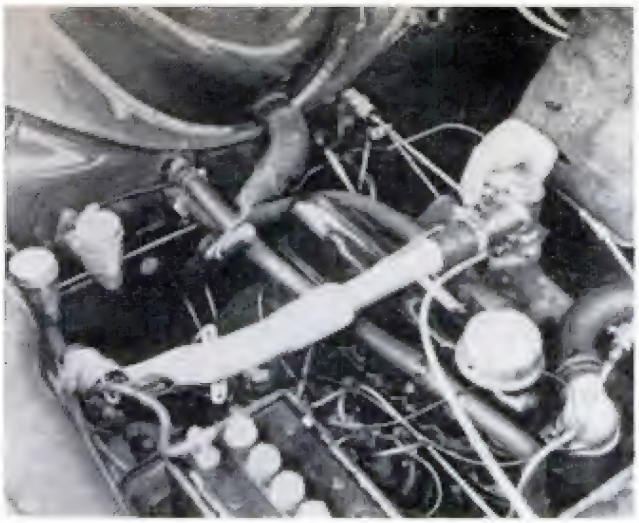


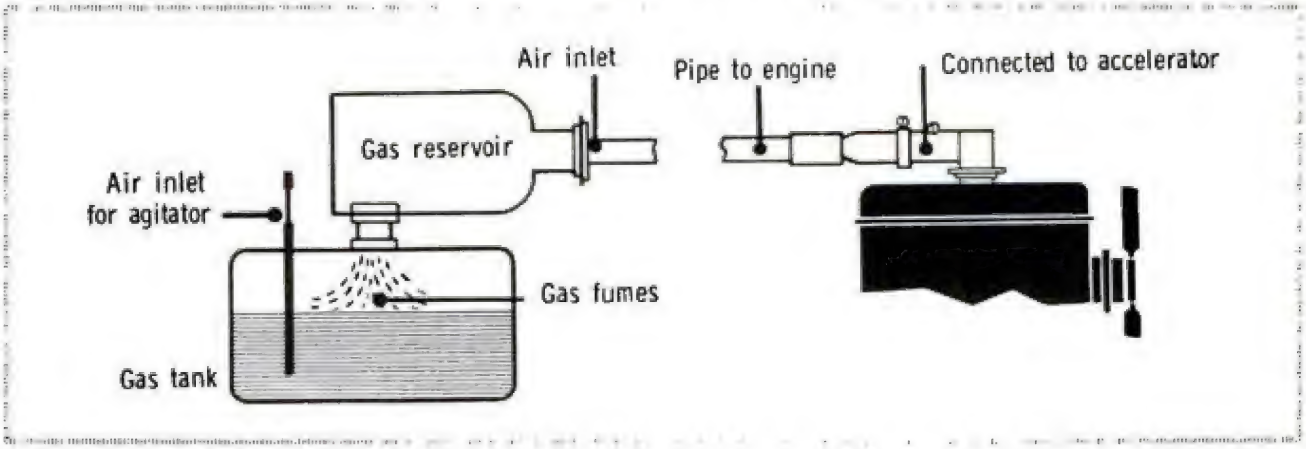
Two-Man Boat Tests Hydrofoils

Designed to accept a variety of hydrofoil configurations, the Royal Canadian Navy's Rx test vehicle is a highly instrumented, 25-foot vessel that carries a two-man crew. It's built of fiberglassed marine plywood. Information from tests is being used in development of a 200-ton RCN anti-submarine hydrofoil ship which will cruise at over 55 mph.

Traveling Golf Clubs Under Par—Weightwise

Taking a set of golf clubs on a trip is no longer a problem of bulk and weight. Porto-club has only one handle, which fits eight clubs. The complete set weighs only 7½ pounds and the carrying bag is the size of an attache case. Clubs and case cost $120 from MS&R Inc., Irwin, Pa.

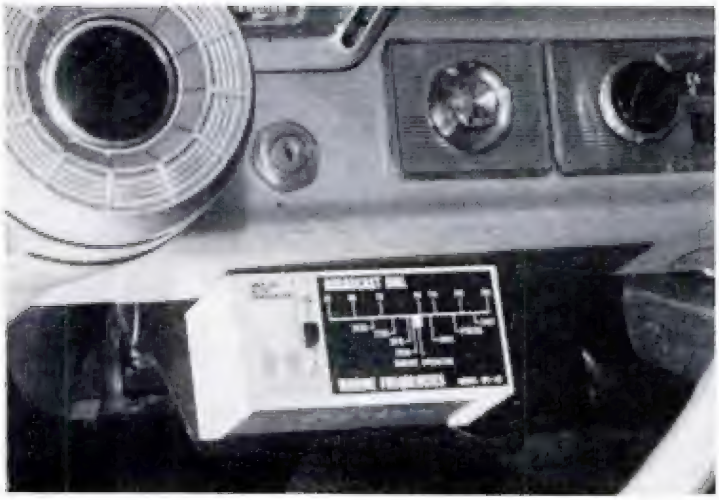




Engine Gulps Gas Without a Carburetor

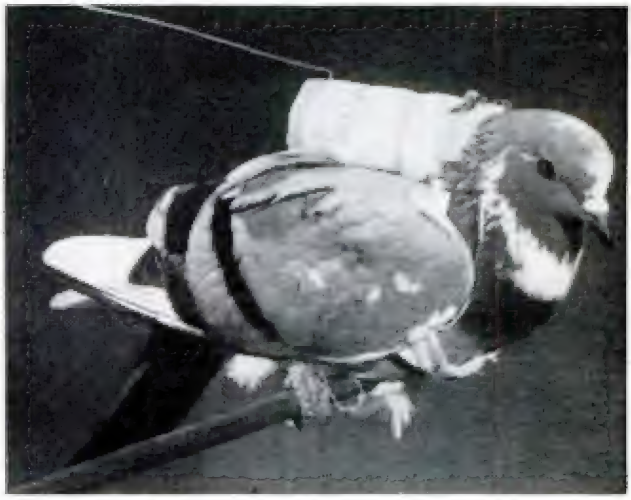
This fuel system needs no carburetor, fuel pump or copper line. Inventor William Scott, a self-taught London engineer, uses a variation of the old system where the engine sucks vapor directly from the gas tank. The large filler tube, open to let air enter, extends to the bottom of the tank. Suction draws in air, which agitates and vaporizes the fuel.

The photo at upper left shows the vapor intake leading to the engine; at upper right is the bottle that serves as vapor tank.



Marine Band for Cars

Using a simple plug-in convertor, you can receive ship-to-ship and ship-to-shore broadcasts on your present car radio. Price is $19.95; Hartman Marine Equipment Corp., Long Island City 1, N.Y.



Tethered Pigeon

Carrying a small radio on its back, a pigeon flies at the end of a fishing line and sends back signals of its heart rate, wing beat and breath rate. The bird is in a Canadian research project.

Tape Home Movies

No more film processing. View your pictures immediately after you take them with a new kind of tape recorder

By Larry Steckler

I SWITCHED ON THE LIGHTS, aimed and focused the camera, pushed the record button and shouted "Action"! Gail, my 3-year-old daughter, cavorted about the room—climbing over the couch, crawling under the ottoman and trying (but not succeeding) to stand on her head—until she collapsed in a wriggling heap on the living room floor.

A push on the stop button and I had just completed making my first home videotape.

Minutes later my wife and I were comfortably settled down before the TV screen. A slight pressure on the playback button, and there was Gail again—over the couch, under the ottoman and trying to stand on her head—this time on the TV screen. And the action was accompanied by all the grunts, screams and laughter that were part of the original action.

This was my first journey away from the familiar world of home movies on optical film and into the wonderful new world

for Your TV Screen

of home movies electronically recorded on magnetic tape.

First impressions? I can't wait to get a recorder of my own. I'll use it for all my movie-taking—oops, TV taping. Reproduction is sharp and clear. "Film" costs are less than for 8-mm color film, figuring about $4 per 50-foot roll. No processing is required and there is positively no waste. If I'm not satisfied with the pictures I'll know it a few minutes later and can reshoot immediately.

I've tried out two of the newest home machines—the Ampex HVR videotape recorder and the Sony TCV-2010 Videocorder. Both are excellent. The Sony recorder is a complete package with a built-in monitor that is as portable as the muscles capable of trundling its 70-pound bulk to the nearest a.c. outlet. The Ampex recorder must be hooked up to an existing TV at a cost of about $25. This obviously reduces its portability unless you hook it to a small screen portable TV.

Prices are high, at least for most consumers. The cheapest Ampex set is $1095 and to this you must add $529 for a TV camera; bringing the total to $1624. This does not include the TV receiver to which the set must be connected.

The least expensive Sony is $995 and includes a compact built-in 9-inch TV receiver. The camera goes for an additional $400 bringing the total cost to about $1400. These figures should drop rapidly with the imminent arrival of competition from RCA, Panovision and Norelco (Phillips). But even at current prices the system isn't much more than a top quality 16-mm sound film system.

Just how much impact these machines can be expected to have on the home movie market is aptly summed up by *PM*'s Midwestern Editor, Clifford Hicks. Reporting from his Chicago headquarters, Cliff comments: "I'm convinced that this is the coming thing. While the machines are designed for recording TV programs off the air, most people like myself probably couldn't care less about recording the Munsters or My Three Sons.

"But I *do* care about recording the activities of *my* three sons. I can now do it cheaply, without worrying about exposure levels and other camera problems. I don't have to send in films to be processed; I don't have to darken a room, set up a screen, get out a projector, thread it and end up with a picture (in most cases without sound).

"I can take a picture of Grandma while she's visiting, and show it to her while she's still there."

Most experts familiar with the new system fully agree with Cliff, and believe that it will be only a short time before TV

tape takes over home movies. A good educated guess? Less than five years.

What makes tape so good? There are many reasons, but here are the important ones:

- An hour's worth of tape costs a trifle less than an equivalent length of 8-mm film and much less than 8-mm sound film.
- Taped pictures include sound—at no extra cost, without any additional equipment required.
- An hour's worth of video tape fits on a 7-inch reel. Two hours fit a 9½-inch reel.
- Pictures cannot fade or distort with storage as long as the tape is protected against magnetic fields. There are no color dyes that might be affected by light.
- You don't need a lightmeter. Simply adjust the lens aperture until the picture on the TV monitor looks good; then start taping.
- Rotating heads that sweep across the tape vertically while it runs through the recorder, give an effective tape speed of about 1000 inches per second (i.p.s.), providing good picture quality, yet reducing tape consumption.
- There is no film to be processed. As with a sound recorder, you simply rewind the play back.
- There are no bad pictures or wasted tape. As well as having precise control before starting to tape, if pictures should happen not to come out right (too dark, too light, Aunt Bertha's head covered up) just rewind the tape and re-record. You can't do that with film.

COMPLETE HOME MOVIE setup comes in two pieces. One is a compact Ampex TV camera; the other is the video tape recorder. TV set is the viewing screen

There are disadvantages too. They will be eliminated, but it will take time. Here are some of them:

- There are no standards. Sony and Ampex systems, for example, are not compatible. The Sony system uses a half-inch tape which runs at 7½ i.p.s. Ampex uses a one-inch tape at 9.6 or 4.8 i.p.s. you can't

AMPEX CONSOLE UNIT, for living-room use, combines large-screen TV with new TV tape recorder

play a tape made on the Sony machine on an Ampex unit and vice versa. Some day though industry-wide standards will be set, just as they were for audio tape recorders.

● No color yet. Present systems record only in black-and-white. They will record color broadcasts, but will play them back only in black and white. The Ampex system is compatible with and can be converted to color by adding some special electronic circuitry at additional cost. It should be available some time in the future. The Sony system cannot ever be used for color unless major technical changes are made in its circuits.

● You must have a.c. power for both TV camera and recorder. This prevents taking pictures on a summer picnic, beach party or vacation trip, unless you have an extra-long extension cord.

This won't remain a problem for long. Power packs that operate from a 12-volt car battery or portable power supply are in the works. There is also news of a miniature camera, battery powered, that records for playback as soon as you get back home.

Sony recorders are available now. According to salespeople at several local appliance stores, they can't wait to get them into stock. Despite the relatively high prices, they feel that sales will really take off.

Initial production will be limited and Sony already has sold its entire production for this year. You may still be able to find an occasional recorder at a local dealer, however. Service will be provided through Sony service centers.

Ampex machines will become available this January in 10 areas of the United States, where Ampex will have established service trucks to install and troubleshoot their sets.

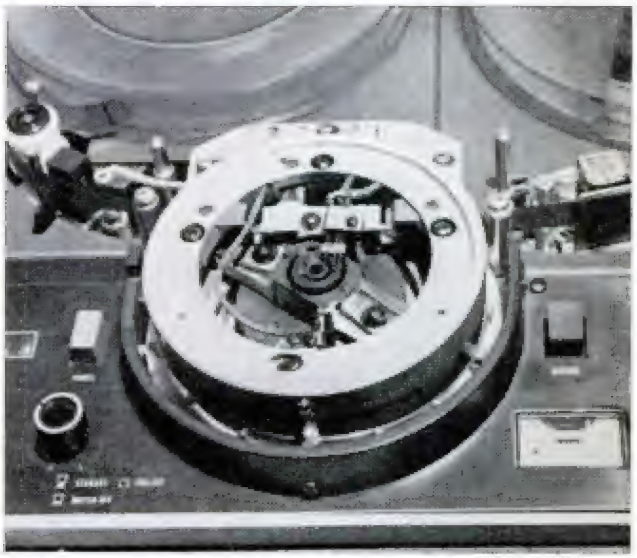
Both machines can tape programs off the air. This can be handy when two good shows are on at the same time or if you won't be home, but would like to catch a particular show.

This may lead to a whole new way of rating TV shows. When the rating service calls they'll have to ask—"What show are you watching?" Then—"What show are you taping?"

TV tape recorders may get off to a slow start. But you may find one in your home before long. ★★★

THREADING THE TAPE on the Ampex video recorder is much the same as threading a conventional audio recorder. Tape width might catch your eye though

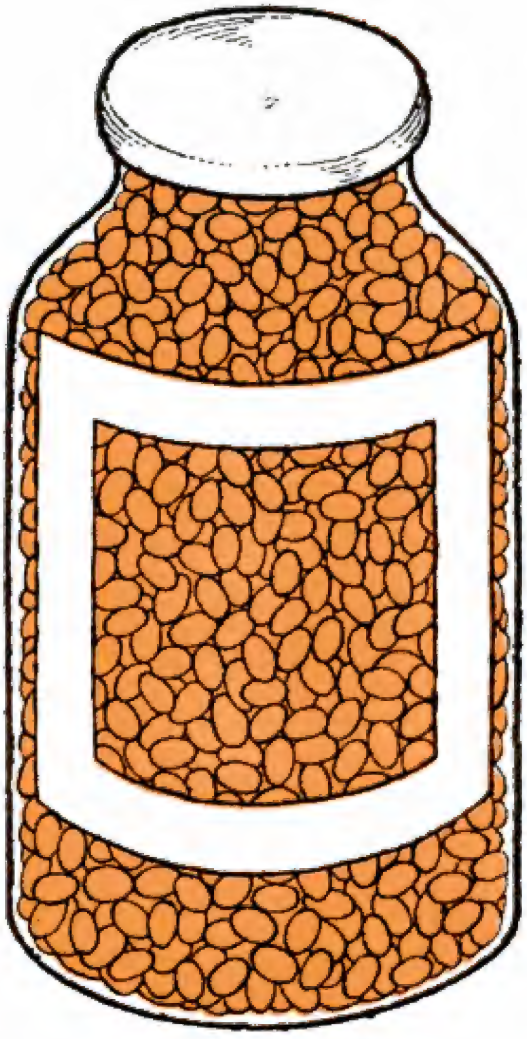
SONY TAPE DECK up close. Controls are simple and easy to use. Operation consists of throwing a panel switch to select record or playback mode



TAPE HEAD COVER removed to reveal the rotating, two-head arrangement that Sony uses. As the heads rotate they are automatically switched into use

How many beans in the jar?

The author, who precipitated rule changes at the "21" tables in Las Vegas when his wizardry at math "beat the house," tells how you can "outguess" an old game. All the formulas needed are here. Good luck!



By Edward O. Thorp
Professor of Mathematics
New Mexico State University

SOME TIME AGO, the papers reported that three college students used their mathematical knowledge to win a guessing game. They estimated the volume of oil in a tank and walked away with the top prizes, worth a total of $1800.

Though the prizes were unusual—unusually generous, at any rate—the game itself was as old as the hills. At one time or another, most of us have tried guessing the number of nickels in a bottle, jelly beans in a fishbowl or beans in a jar.

As the college boys demonstrated, with a little know-how you can "outguess" a guessing game of this kind. To keep things simple, I'll limit the discussion to beans.

The obvious solution to the problem is to get the same kind of jar and the same kind of beans as used in the contest. Fill your jar with beans to the same height as the contest jar. Then count the beans. Do you think you'll get the correct number? Chances are that you won't.

How Errors Creep In

First, there may be a small error due to a slight difference in size between the two jars. This error is probably too small to matter but if you are worried about it, you can get several jars and figure out how much they vary. You can do this by filling each with beans and counting. A quicker and more accurate way is to fill each jar to the proper height with water and compare the amounts of water each holds.

A second reason your answer may be off is that beans are of varying sizes and shapes. As a result, the

number in a given volume will vary somewhat. To get an idea of this fluctuation, fill the same jar several times, always with different beans, and count the number in each case. If the jar is large and counting the beans is impractical, do the same thing with a smaller jar. This will give you an idea of the variation in the big jar.

Suppose, for example, that the contest jar is 70 quarts and you use a one-quart jar. If the quart jar gives numbers like 980, 1000 and 1020, then you'd expect that the big jar, which is 70 times larger, to give numbers like 70 x 980, 70 x 1000 and 70 x 1020.

Uncertainty in the closeness of packing causes a third error. If you fill a sugar canister and then shake it from side to side, the sugar will settle and more may be added. The beans, like the sugar particles, can be packed closer together by shaking the jar.

One way to get an estimate of this "packing factor" is to count the number of beans that touch the inside of the contest jar and the number touching the inner surface of your own jar. These two figures will give you a ratio or packing factor.

But there may be just too darn many beans to count. You can simplify the task by marking off an area or "window" of known size and shape—a square works best—on the side of the contest jar. Count the beans touching the side of the jar within this area. Do exactly the same thing with an identical window on the side of your own jar.

Let's say that the number of beans seen through the contest jar's window is C and the number seen through the window on your jar is W. Since lengths behave like square roots of areas (the length of the side of a square equals the square root of the area of the square), it follows that the average center to center spacing of beans in the contest jar is approximately $\sqrt{C/W}$ times as great as it is in your jar. You can get the square root of C/W from mathematics tables or a slide rule.

Volumes behave like cubes of lengths and from this it follows that the number of beans in the contest jar is the cube $(\sqrt{C/W})^3$ times as great as it is in your jar. (The cube, N^3, of a number N is NxNxN; the cube of 2, for example, is 2x2x2 or 8).

Switch to Small Jar

If the container is very large and it is impractical for you to count the beans (the contest sponsors may have a machine to do it for them), take a smaller container and fill it with beans. Count the beans. Then see how many of these smaller jars are needed to fill the big jar. Multiply to get the total number in the big jar. To get an idea of the error involved, try the method several times and note the "spread" in the results.

Suppose a jar like the contest jar can't be obtained. Then we can proceed by estimating the volume of the

(Please turn to page 206)

Drawings by Alice Golden

Stadium Built Like a Tinkertoy

It took skiers and boat drivers at the Cypress Gardens, Fla., water show only 10 days to construct this aluminum and steel "photo" stadium. The structure came in kit form—13,000 identical struts, 3000 identical joints and 33,000 bolts—and required only small power wrenches for assembly. The components were made by Up-Right Scaffolds, Berkeley, Calif.

Have a Soda—on Credit

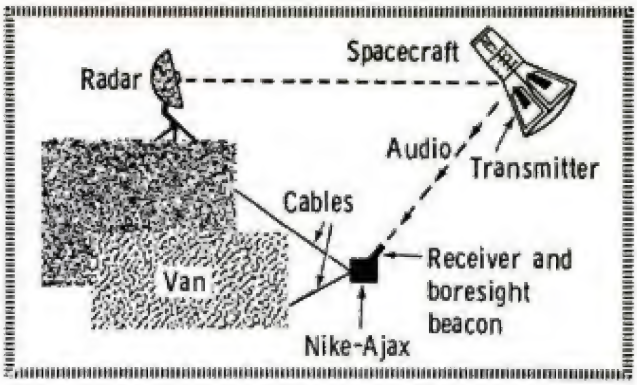
A new credit card for vending machines ends the search for proper denomination coins. Insert the card, select the desired item—and you'll be billed later. The Automatic Canteen machines also take coins.

Infrared Fire Spotter

Incipient forest fires are spotted by an externally mounted infrared scanner that senses heat sources and simultaneously takes a continuous strip of pictures of the ground from altitudes up to 4000 feet.

Astronaut to Talk by Laser

During the Gemini-7 orbital mission next year, Astronaut James A. Lovell will try to talk by laser beam with colleagues stationed at White Sands, N.M. He will wear protective glasses when he aims the laser transmitter, as demonstrated below, through window of the space craft at a beacon on the ground. Communications system to be used is diagrammed at right.



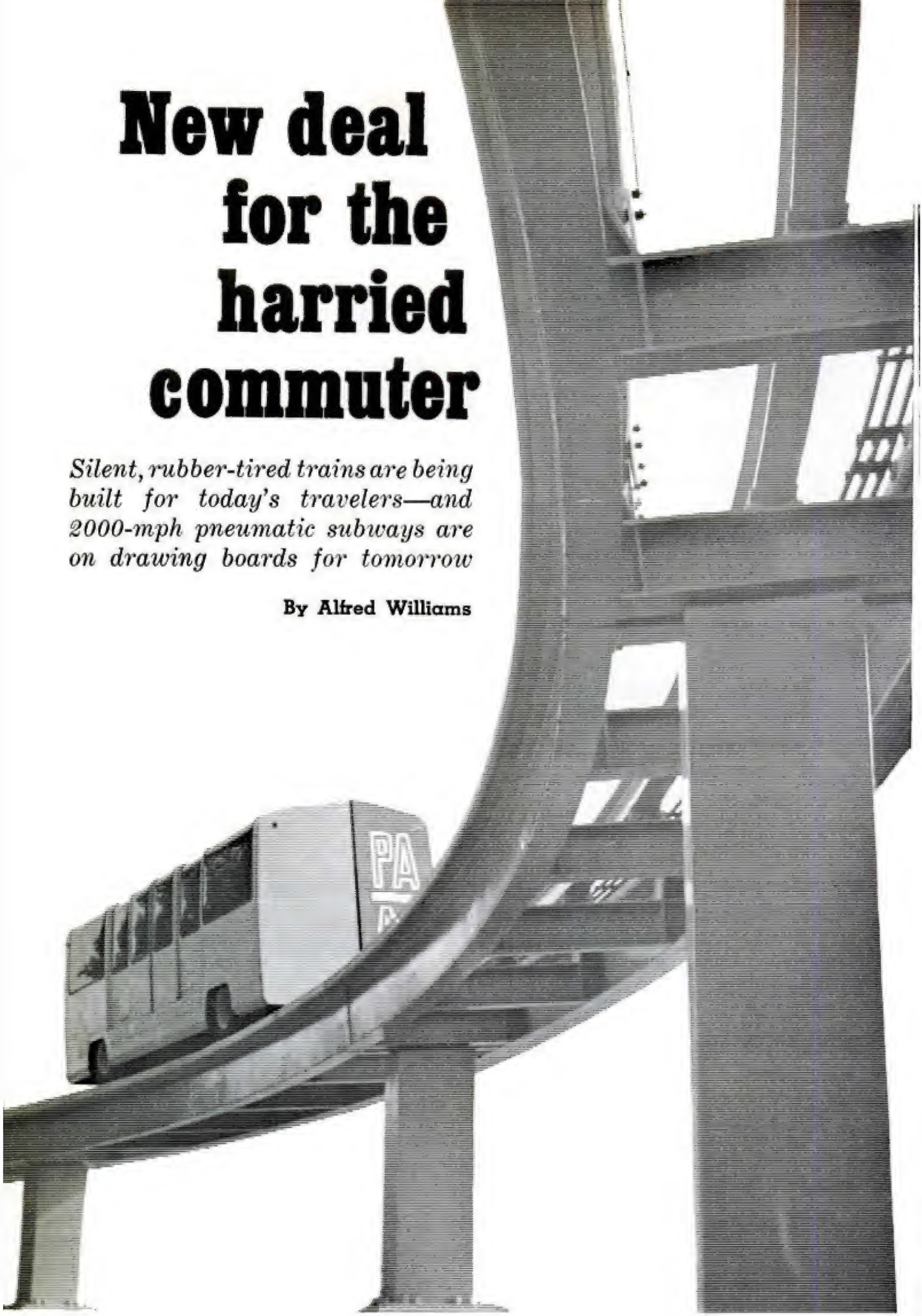
Volkswagen Will Introduce Fastback Sedan

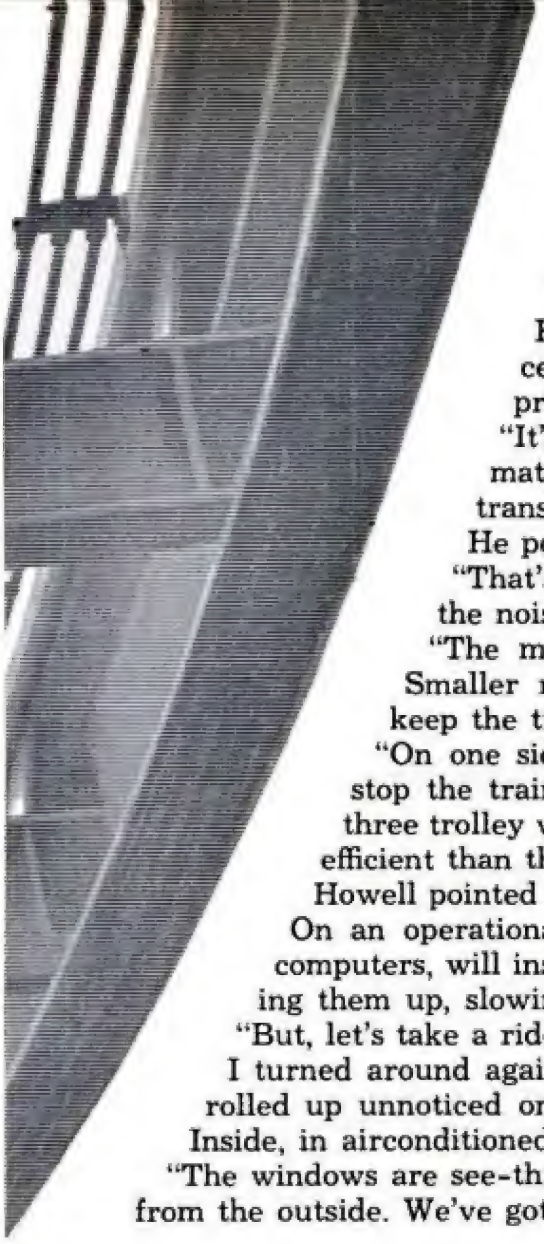
A fastback sedan, powered by a 65-hp, air-cooled rear engine, will debut in Volkswagen's 1966 lineup. The car has front disc brakes, four-wheel independent suspension, and carries five passengers. A second version of the car, a station wagon, will appear at the same time.

New deal for the harried commuter

Silent, rubber-tired trains are being built for today's travelers—and 2000-mph pneumatic subways are on drawing boards for tomorrow

By Alfred Williams





"IT'LL BE ALONG IN A MINUTE," Dixie Howell said in his North Carolina drawl. "Meanwhile, let's look at the tracks."

We moved to the edge of the platform and J. Kendall Howell, project engineer on a revolutionary new concept of transportation, described with a professional's pride what it's all about.

"It's silent, or about as silent as you can get. It's automatic. There's no motorman. And it's definitely a rapid-transit system. It has its own roadway."

He pointed to the cement tracks.

"That's new. The trains run on rubber tires, so we've eliminated the noise and weight of metal wheels and metal rails.

"The middle rail is simply an I-beam used as a guide rail. Smaller rubber wheels, mounted horizontally, ride the slots to keep the train on the track.

"On one side the antenna picks up command signals to start and stop the train and open and close the doors, and on the other side three trolley wires furnish the power. This three-phase system is more efficient than the old single trolley."

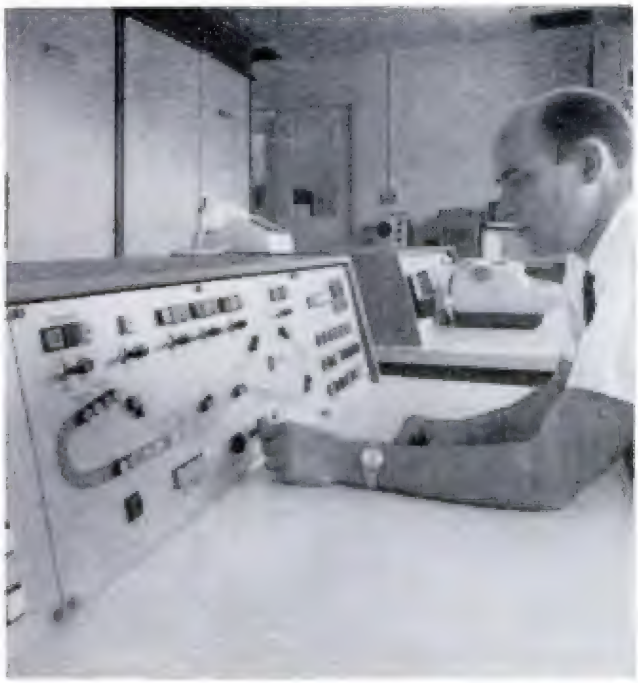
Howell pointed to a building behind us. "It's all controlled from in here. On an operational system we'll have wayside controllers that, through computers, will instantaneously control all trains within their area, speeding them up, slowing them down, spacing them.

"But, let's take a ride."

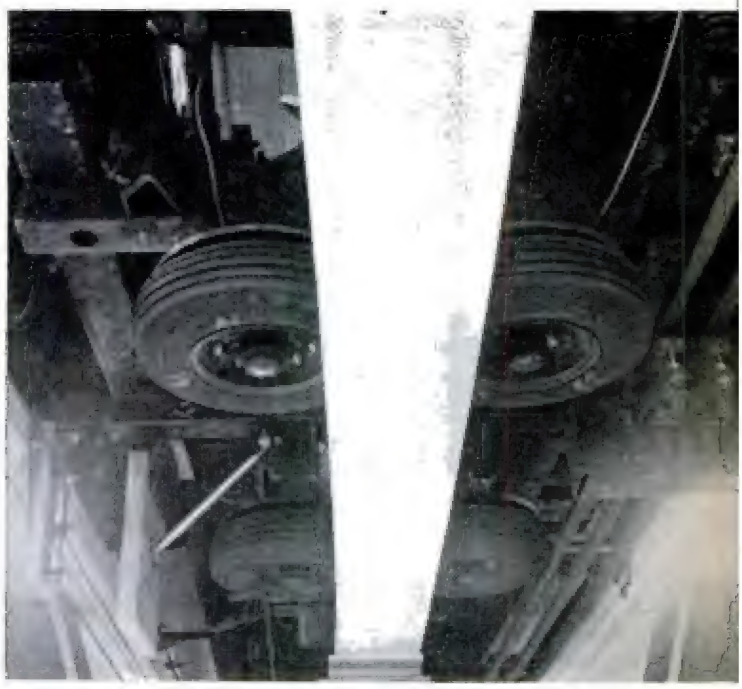
I turned around again and was shocked. The car was standing there. It had rolled up unnoticed on its silent rubber wheels.

Inside, in airconditioned comfort, Howell explained what to expect.

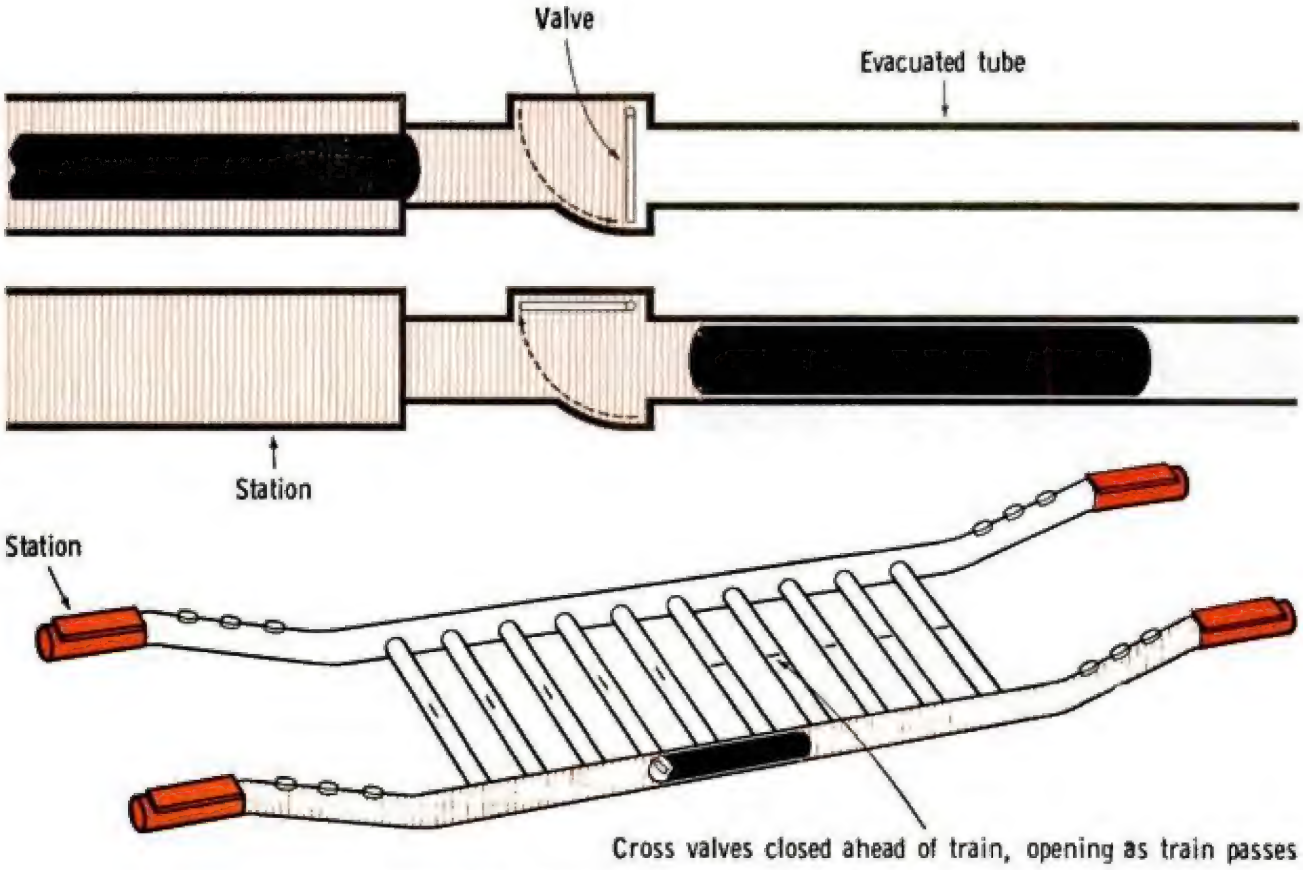
"The windows are see-through mirrors, glare-cutting from the inside and opaque from the outside. We've got seats," he said, patting the cushion beside him, "for 28,



RUBBER-TIRED TRAIN (left) will be controlled by computers (above) from wayside stations, giving passengers silent and automated ride without motorman



PITTSBURGH TRAIN is held on track by small guide wheels that ride center I-beam. Antenna (left) picks up signals and trolleys (right) furnish power



PNEUMATIC-TUBE TRAIN borrows principle of department-store tubes. Stations are at atmospheric pressure, while tubes are near vacuums. When valve opens, pressure pushes train into tube and accelerates it at controlled rates. As train condenses air in front of it, eventually equalizing air before and behind it, it begins to decelerate. Acceleration and deceleration valves, plus cross valves, help control amount of pressure in tube

DR. FOA'S TUBE TRAIN uses another principle, pulling air from in front of vehicle and pushing it out behind without appreciably disturbing air's stability

SAN FRANCISCO TRAIN, already being built, will carry motorman, but only to monitor automated system. Ten-car trains will be computer-controlled

with standing room for 42 more in each car, and we can link up to 10 or 12 cars together for rush-hour traffic."

While he was talking the car, eerily, began moving. There was no driver. In fact, there was no room for one.

"All the electronics gear is in the end walls," Howell said. "That drives it."

All I could hear was a hum, and an occasional click-clack when the guide wheels passed the juncture of two I-beams that weren't aligned properly. The ride around the two-mile twisting track, while remarkably silent, wasn't noticeably smoother than a New York subway.

"I think when we make smoother bends in those I-beams on the curves, we'll solve some of our problems."

The ride took us around Pittsburgh's South Park, where Westinghouse Electric Corp., with its own and federal, state and local funds, built the prototype of its transit expressway. We moved from ground level to elevated tracks supported by single pillars.

"The single pillars take up less space than old elevated systems. In fact, along one stretch here," he pointed out the window, "a double track is supported by single pillars. We could set this up in the center of almost any street without disrupting too much ground traffic, or along the center island of an expressway."

Pittsburgh, which has no rapid-transit system, may be Westinghouse's first customer, although queries have come in from all over the world.

The Pittsburgh test, however, while much further into the hardware stage, is just one of many new and novel concepts for moving people from one place to another. The coming revolution was born in necessity. Except for aviation, which developed jets and is now working on a supersonic transport and vertical takeoff-and-landing aircraft, no improvement in ground or water transportation has taken place in half a century.

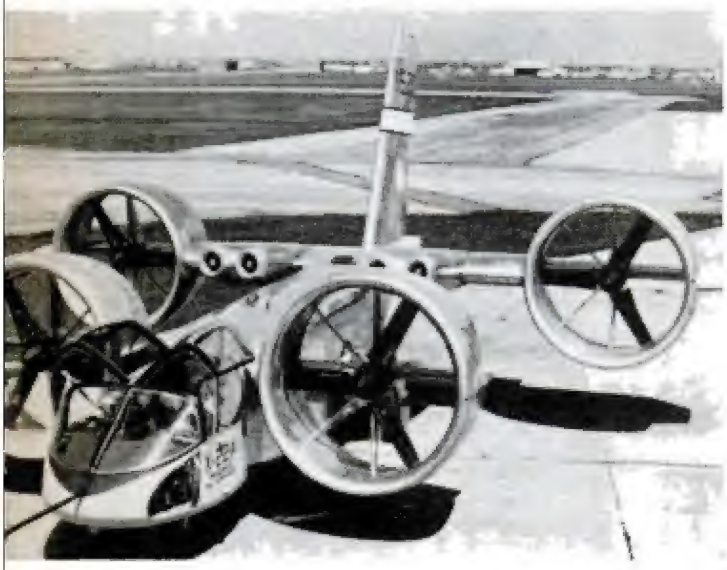
Now, within our lifetime, we may see jet-powered automated trains that will skim along on a cushion of air at 200 mph, passenger-carrying capsules that will rocket from coast to coast through tubes at 2000 mph, and hydrofoil passenger ships that will cross the ocean at 100 mph.

Even President Johnson, when he asked for studies of "high-speed rail transportation," indirectly endorsed the criticism that present systems are becoming obsolete.

Perhaps the first rail system to "get off

HYDROFOIL LINERS, once a novelty, are now in daily commercial use in all parts of the world. Navy and Maritime commission are experimenting with models that may carry military or commercial passengers at 115 knots

BOSTON-WASHINGTON TRAIN, asked by President Johnson, may be something like this model proposed by Budd Co. Makers say it could go up to 160 mph



UNIQUE VTOLS, aircraft that go straight up and straight down, could relieve congestion around airports by taking off and landing in downtown areas

the ground" will be in the San Francisco Bay area where work has already started on an automated (no-driver) system.

"The control system must stop trains within six inches of a given spot," B. R. Stokes, general manager, told our man on the West Coast. "It must operate all functions—starting, stopping, accelerating, decelerating and opening and closing doors —during peak rush hours, when 450 cars in various train lengths will be operating at speeds up to 80 mph and as close as 90 seconds apart."

Darrell Halligan, manager of the test track operation, took our man out to the track where a model car has been put through its paces. "We plan 20-second station stops, and hope to carry 30,000 seated passengers an hour in each direction."

Seated passengers?

"Seated. We hope to operate enough trains frequently enough so no one need stand. Our average speed will be 40 to 50 mph, including station stops, twice as fast as any existing rail transit system."

In spite of automation, seated comfort and all the rest, the San Francisco system is only a short first step in the direction some transportation planners are thinking.

A British inventor, Christopher Cockerell, for example, has built a six-ton model "Hovertrain" with a 240-hp jet engine to blast it into a hovering position a half-inch from vertical and horizontal surfaces of a T-shaped concrete "rail." From that position, even a child's push can send it skimming frictionlessly over the rail. With jet power or a linear induction motor, which has no moving parts, such a train easily could travel 400 mph, he claims.

Studies at the Massachusetts Institute of Technology are exploring several high-speed railway concepts. One futuristic system might shift passengers from one moving train to another in large capsules, allowing transfers from express to local trains, without slowing either.

"Control problems will be critical, demanding mechanisms and techniques which don't exist now," the study group reported. But support is growing for such projects. In addition to President Johnson, former Secretary of Commerce Luther Hodges urged a full-scale feasibility study of such a high-speed line, and Democratic Senator Claiborne Pell of Rhode Island has introduced a bill to create an authority to finance and operate a line between Washington, D.C. and Boston.

Even more revolutionary than jet-propelled "Hovertrains," however, is a long-distance transportation system designed by Dr. Joseph Foa, head of the department of aeronautical engineering and astronautics at Rensselaer Polytechnic Institute. It propels passenger projectiles through tubes at up to 2000 mph.

"Land vehicles are necessarily constrained to travel along narrowly defined paths," he says. "Therefore, unless the prescribed path is a straight line, a land vehicle traveling at high speed must be supported from all sides. This kind of support is best provided within a tube.

Moreover, enclosure makes possible a unique kind of propulsion that would give the vehicles tremendously high speeds and acceleration and deceleration rates. That is, simply to pull the air from in front of

(Please turn to page 250)

How That New Rocket Gun Works

IT LOOKS AND ACTS like a handgun, but the Gyrojet is really a launcher for rockets.

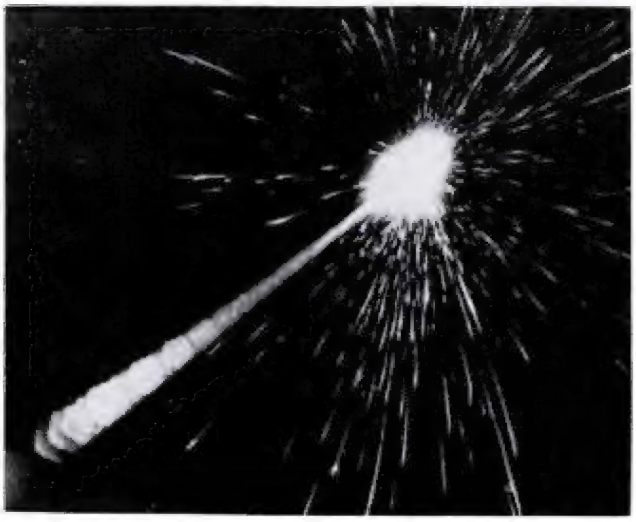
A Gyrojet round is a cartridge-shaped hollow piece of steel that weighs 185 grains at the target. Its peak thrust is 1250 f.p.s., giving it roughly twice the oomph of a GI .45 cal. round or approximately equaling the .375 Magnum cartridge.

Inside the Gyrojet is a stick of standard solid rocket fuel coated with inhibitor and fitted with a pellet of igniter. The rear of the case is closed by a crimped-in steel disc drilled at center for a standard rifle primer cap. Surrounding the primer are four ports, spaced equally and canted clockwise.

When the primer is hit by the firing pin, it is like a miniature rocket launch.

For an unguided rocket, a Gyrojet is quite accurate, although any quality cartridge handgun is more accurate. The makers, MB Associates of San Ramon, Calif., have priced the gun at $250, and they are offering a guarantee that it will shoot inside five mils C.E.P. (Circular Error Probability), which means a 20-inch circle at 97 feet.—*Ken Warner.*

DIE-CAST OF ZAMAK AND ALUMINUM, Gyrojet handgun shoots .51 cal. rockets and recoil is almost unnoticeable



SPRAY OF LIGHT in this night shot shows the rocket hitting a steel plate. The light pattern is the propulsion flame from the rocket's canted jet ports

COPPER ALLOY SHEET withstood the impact of a GI .45-cal. solid ball at 100 feet, but the high velocity 13-mm Gyrojet rocket punched right through

Whatever Became of the Village Blacksmith?

By Clarence B. Randall
Retired Chairman, Inland Steel Co.

AT THE TURN OF THE CENTURY, when I was a small boy living in the country in southern New York state, I all but worshipped our village blacksmith.

His shop was right by the bridge over the brook. For me and my gang there was nothing more exciting than to go down there, stand in the doorway, and just watch all that went on. In the center was an anvil, with five or six big hammers hanging on the wall near it, while in the corner stood the forge, where a slumbering fire would suddenly come to life whenever that man of brawn would pump vigorously on the hand bellows. A big white horse might be standing near the anvil, and I can still see Mr. Nowland (we always spoke of him with great respect) lifting one of the animal's hooves, resting is upon his leather apron, and touching it momentarily with a shoe so red hot that it hissed as he tried it on for precision sizing and shaping.

Shoeing horses, however, was only a part of Mr. Nowland's daily chores. He could do almost anything. If my mother's pump handle broke, he could make a new one. If a pipe came loose in the church organ, he knew how to repair it. In winter, if the runner came off a farmer's sleigh, he could fix it. The more unusual the challenge, the more confident he was that he could meet it.

But quite apart from these unusual skills—or rather, because of them—was his pre-eminence as a leader in the community. He was the superintendent of our Sunday School, the chairman of the church trustees and amazingly, the representative of our county in the state legislature.

How different things are today in the community where I live. There are no "handy" men in the sense that my father used that term. If a repair job has to be done at my house, a half dozen workmen may have to be called in before it is finished. If the plumber, in fixing a pipe in the bathroom, has to cut a hole in the wall,

MR. RANDALL is easily as versatile an individual as the blacksmith he writes about. He is a lawyer, economic expert, author of books and magazine articles, college trustee and student of ornithology. He has served the government in various capacities. In 1956, he presided as the chairman of the Council on Foreign Economic Policy

after him may have to come the plasterer, the painter and the paperhanger; to say nothing of the carpenter if the floor becomes involved. Each of these men is an expert in his field, but each must stick to his craft. This is a penalty which we must accept if we are to have the values inherent in the increased productivity which this reorganization of society has brought to us.

In the manufacturing processes of our great industrial plants it is specialization which raises quality, and lowers for all of us the price of the product. Admittedly, the fragmentation of responsibility in production may at times bring a narrow focus to the effort of a particular worker. But many Americans have a distorted image of the modern assembly line: men and women standing all day long, performing repetitive activities with a deadly monotony, having inevitably a completely empty mind, and being rewarded with no pride of craftsmanship whatever.

This picture I challenge. I do not accept the concept that our situation with respect to specialization is so critical that we must deliberately turn back and try to recapture the era of the village blacksmith. It is the very intensity of our intelligent modern methods, with their resultant enrichment of the effort of the individual, that has made possible the enormous increase in our material welfare.

We must never forget that the more wealth we create collectively, the more there is to share among us. Let us count our blessings. I am very sure that no one of my father's neighbors at the beginning of this century ever in his wildest dreams foresaw the general prosperity which we in the United States are now enjoying—and without specialization that could not have come to pass.

The village blacksmith was an exceptional case. He had one of the rare opportunities in those early days to develop an impressive array of diverse skills, and to sense to the full the deep inner satisfaction that comes from imaginative, self-generated effort. The lives of most of his contemporaries, however, who also lived by the sweat of their brows, were dull and dreary beyond description.

Take the man in the fields, for example. Often as a boy I visited the farm of my uncle during the harvest season. When it

(Please turn to page 212)

Rattle up a deer this year!

Deer "rattling" is almost a forgotten art, but with a pair of antlers and a little practice anyone can bring a buck on the run.

By Pete Czura

IF YOU WANT to add a new dimension to deer hunting this fall, try rattling them up!

The art of calling deer is as ancient as deer hunting but only a handful of sportsmen know about the "rattling" technique, which can be one of the most productive systems to bag your deer.

To become a "rattling" deer hunter is simple. Take a pair of deer antlers, cut them apart, and when you are afield just slam them together to make it sound like a pair of bucks battling. Bucks hearing this commotion will come lickety-split toward the sound of the antlers being banged with the idea of whipping the winner and acquiring another doe.

Battles among bucks are common, especially during the breeding period—the rut—which usually begins with the first chilly nip in the fall. Ruts generally last 6 weeks but have lasted as long as 8 to 10 weeks.

Pick a set of heavy-beamed antlers for your rattling. The sounds of such a pair being banged together will carry the greatest distance. After you have picked a likely spot to hunt, pound the antlers together, twist them back and forth a few times, then slam them together again. Feisty bucks don't back off and keep crashing at each other when battling. After their initial fierce clash, live bucks then rake their antlers back and forth, heads lowered, struggling to obtain a good position in order to render a crippling blow.

Choosing the right kind of rattling antlers can be important. Successful deer "rattlers" have found that mule deer racks are better for this kind of work than white-tailed antlers, because the muley racks are straighter, whereas the whitetails have inward curve, and these make it tough to slam them together properly to imitate a buck battle.

To prepare "rattling" antlers, saw them off at their base on the deer's head and then let them season—dry out. A set over a year old will most likely have a phony ring. And to make your chore of toting your rattlers easy, when heading afield, tie your two "rattlers" together with a cord and sling them over shoulder for easy transportation.

Russ Tinsley, author of "Hunting the Whitetail Deer" says, "Contrary to popular belief, antlers should not be rattled together with the tine points facing each other, as they appear on the deer's head. Rather, the points go in the same direction, with the curve of one antler banged against the curve of the other.

"Avoid using a set of light 'rattling antlers,'" Tinsley recommends. "They will more likely bring in only small bucks. For mean, belligerent, big bucks, use heavy antlers and whack them together slowly, but with great force."

When rattling up your deer it's important to remember that if you want to score you must get your quarry to hear your rattling. The sound of your imaginary buck fight won't carry over 400 yards most of the time. This means you must pick a spot where you know big bucks hang about. A still, clear, cold morning is

(Please turn to page 210)

READY FOR BATTLE, a big buck comes charging into the clearing where he thinks a pair of bucks are fighting. The ideal method for rattling (below) is simply to make certain that the points of the antlers are in the same direction when being banged together to simulate combat

Hot New Ideas in

Boilers the size of attache cases; add-on heating plants for remodeling; reservoirs that retain heat—they sound futuristic, but they're here now!

By John Ingersoll

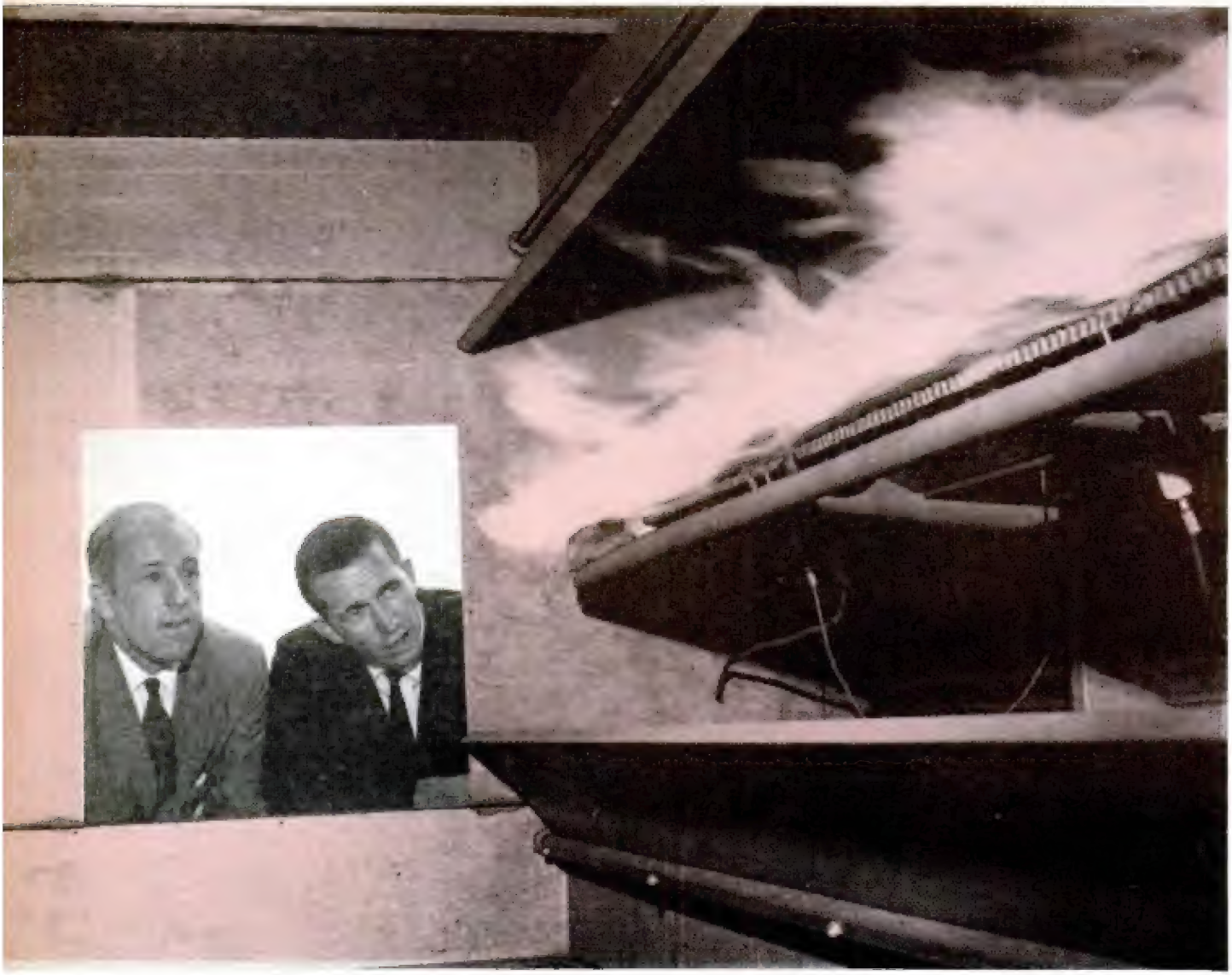
GEORGE WASHINGTON, if he were alive today, wouldn't believe it!

At the House of Decision, Washington's headquarters at Washington Crossing, Pa., there is the large bed where the General slept, and it is equipped with a bundling board. A sign by the bed explains that the old stone house was so poorly heated that when Washington received guests they would take to the bed, fully clothed, the board separating them. Piled high with down quilts, they would discuss the business of the day in warmth.

How things have changed. While it's probable that Ben Franklin had told the General about electricity, who would have thought that it would replace the bundling board? And not just electric heat, but an entire wall of radiant heat with push-button control?

That's just a sample of what's hot in the world of heat. The way things are going, the next generation will view the basement oil furnace in the way we now treat the fireplace—a charming, but useless

Direct-fire heating system burner



Home Heaters!

piece of memorabilia. The fuel oil truck may be as useless as the ash can.

Take the new electric heat bank, for instance. In Philadelphia 11 homes are field-testing a heating system called Therm-Bank that stores electrically-generated heat in a combination of chemical salts. With this system you can run the electricity during the low-rate off-peak hours, charging the salts to heat the house the next day.

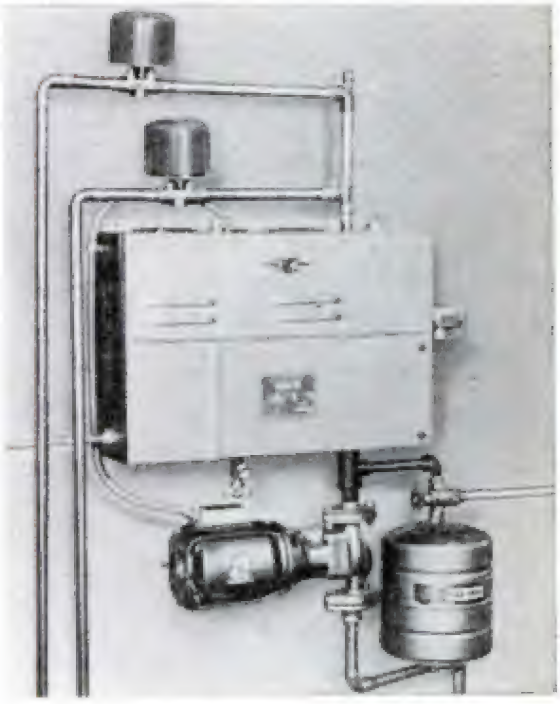
The bank is an insulated steel-cased box large enough to house a trailer-truck engine. The size is still a problem. The salts are collected in separate steel containers inside.

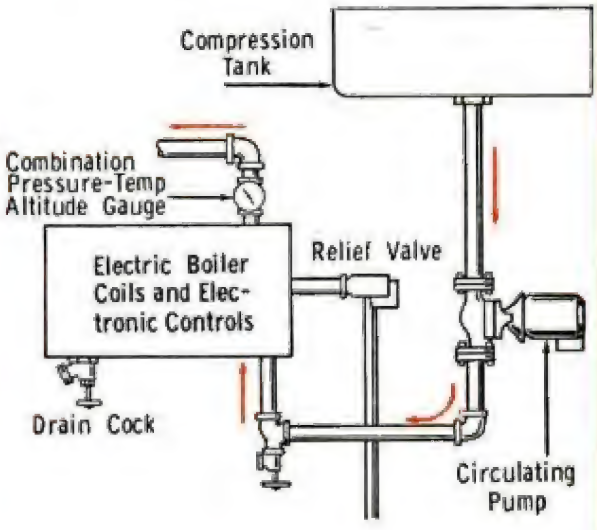
At full charge, the salts are in a molten state at about 900° F. When the thermostat calls for heat, air is passed through the box, heated to its correct temperature, and sent through conventional ducts. Although the bank was designed primarily for heating, it's ideally suited to team with a heat pump for a full heating/cooling cycle. Ten of the 11 test installations are Therm-Bank-heat pump combinations.

The system was developed originally by the Philadelphia Electric Co., and test prototypes were manufactured by General Electric. If the test results over the next several years are positive, these units will be available to the public.

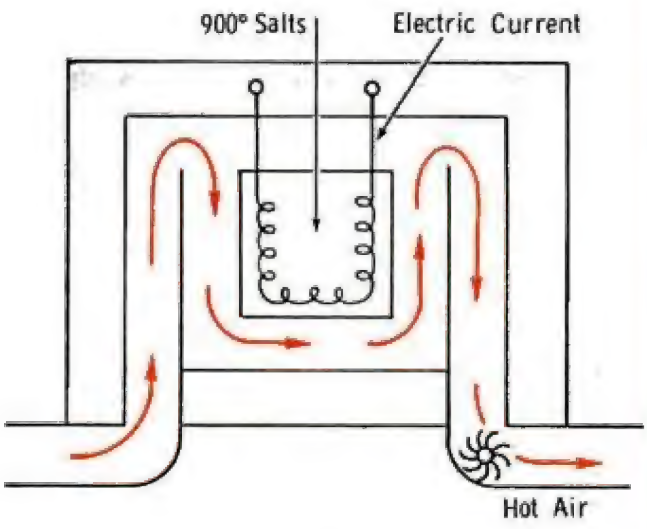
For something new that is already on the market, there are the electric boilers. These are nothing more complicated than piped water, heated electrically. But the boiler is big enough to do a whole-house heating job, and the unit packs into a space not much larger than an attache case. The entire works can be fastened inconspicuously to a basement or utility room wall. On the average, installation

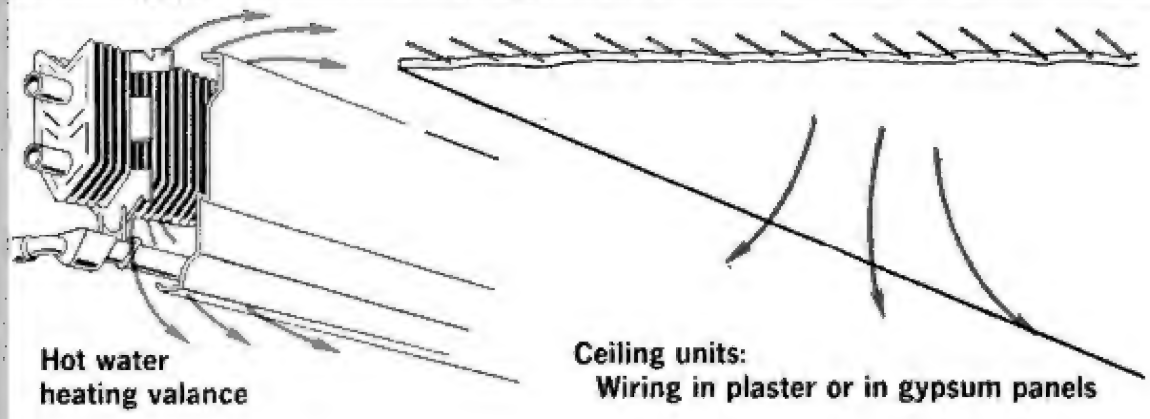
Thermo-temp electric boiler and how it works

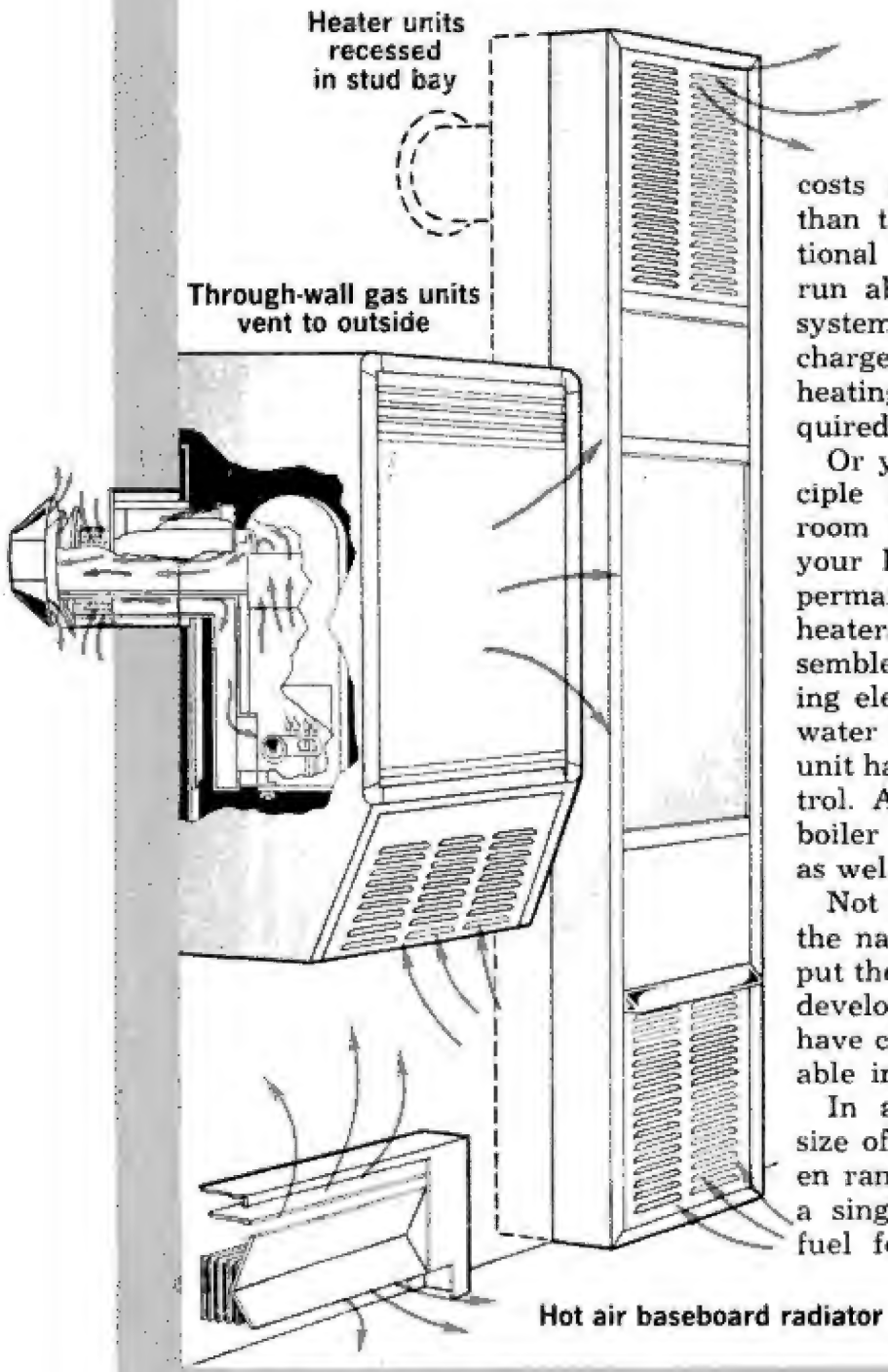




Gas or oil heat bank—hot air





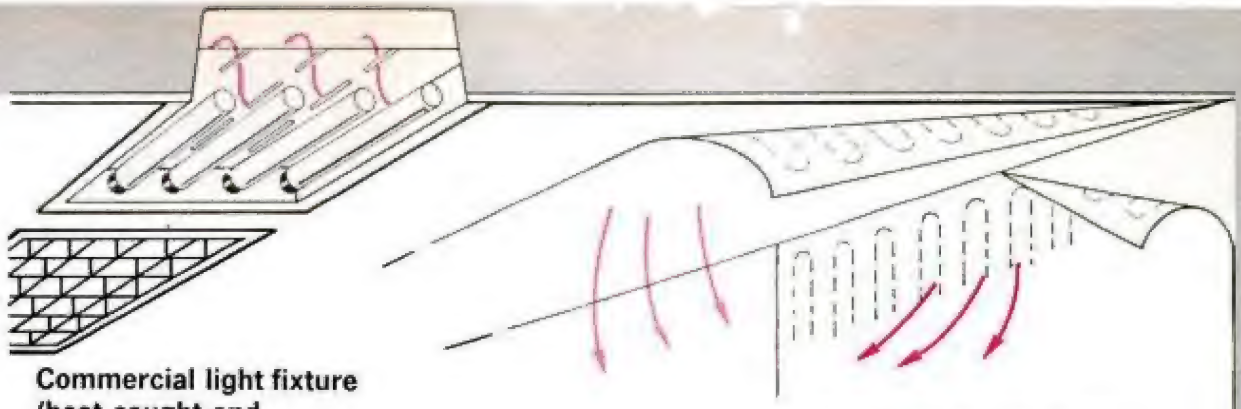


costs are about 10 percent less than the price tag on a conventional system. Operating costs run about equal to a flame-fuel system, and are less than the charges for electric resistance heating. A separate system is required for domestic hot water.

Or you can put the same principle to work heating a single room (one that's been added to your house, for example.) Both permanent and portable room-size heaters are available. They resemble fin-tube, baseboard heating elements in an ordinary hot-water heating system. And each unit has its own thermostatic control. Any version of the electric boiler is great for remodeling as well as new work.

Not to be left out in the cold, the natural gas industry has also put the heat on their research and development people, and they have come up with some remarkable innovations.

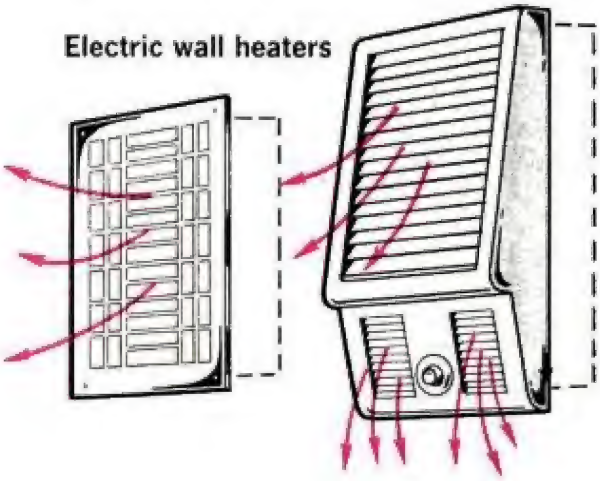
In a piece of equipment the size of a normal, stand-up kitchen range (and it looks like one), a single gas connection delivers fuel for four cook-top burners,



Commercial light fixture (heat caught and circulated through ducts)

Wires in vinyl surfacing

Electric wall heaters



plus a condensed "hydronic" heater powerful enough to pour out heat and domestic hot water for an apartment or small southern house. (Output is about 49,000 B.T.U. per hour.) There's even space in the unit left over for pot and pan storage.

Electric furnaces that heat air over electric resistance coils and then force it through the heating system have been around for some time, but now a cooling coil has been worked into the system for airconditioning. Consistent with the general trend toward smaller equipment, the unit is only 46 inches high, and can push air down from an attic or up from a utility room or basement.

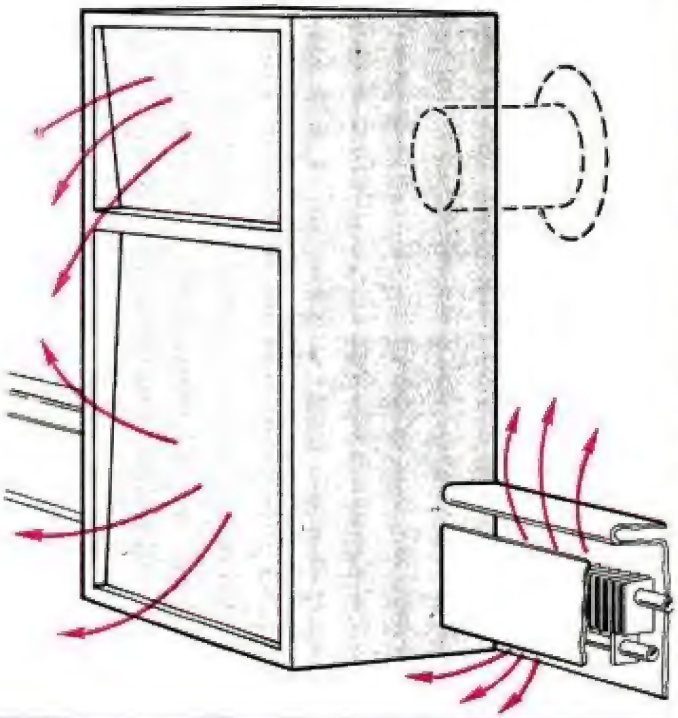
Electric ceiling board, designed for radiant heat, has an electric grid sealed in each panel during the manufacturing process (page 135, Sept. '65 *PM*).

Sealed combustion chamber gas heaters are a new innovation for on-the-spot gas heat. This is now possible because each of the units feature direct "thru-wall" venting. Depending on heater size, the

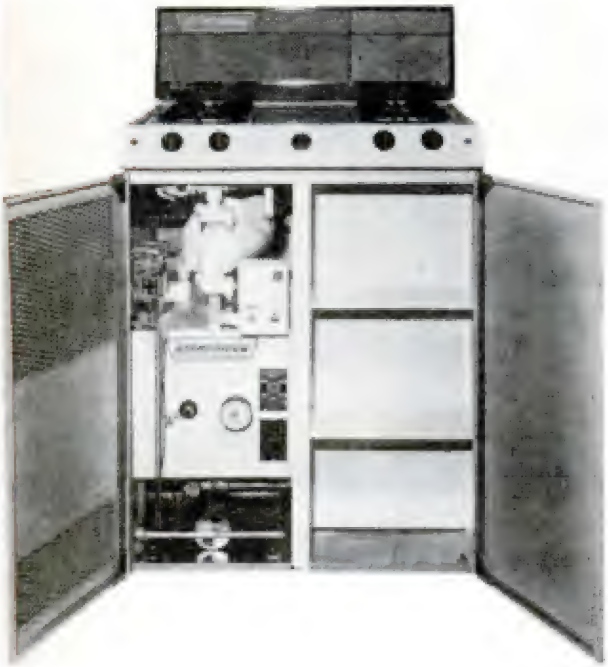
(More drawings on page 114)

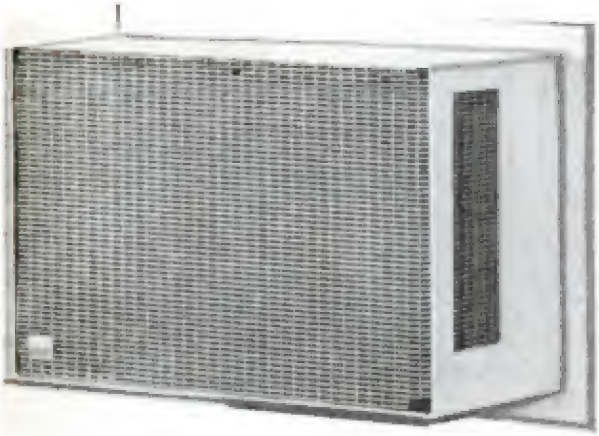
(Text continues on page 232)

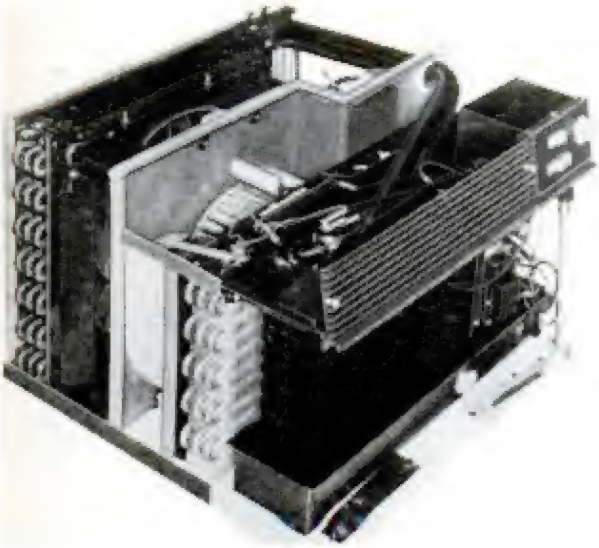
"Furniture" furnace is actually gas boiler for hot water baseboard radiator



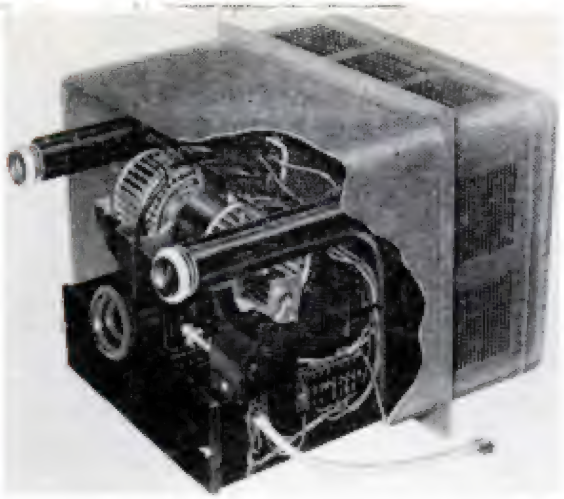
Gas heater—air conditioner units



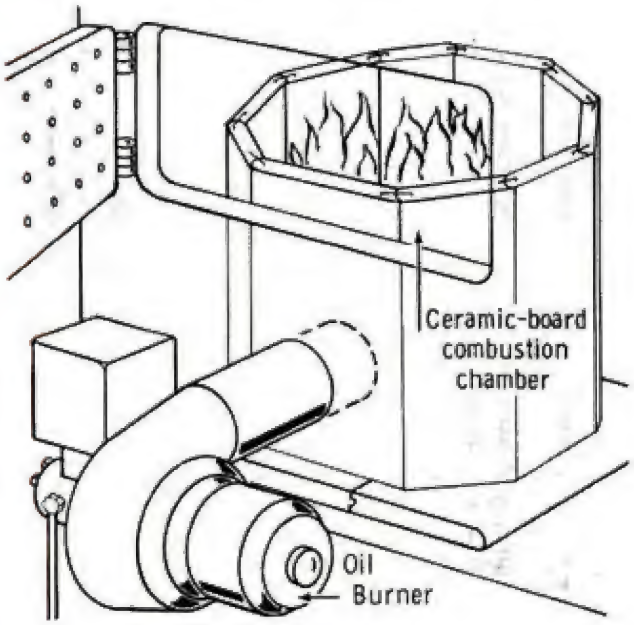




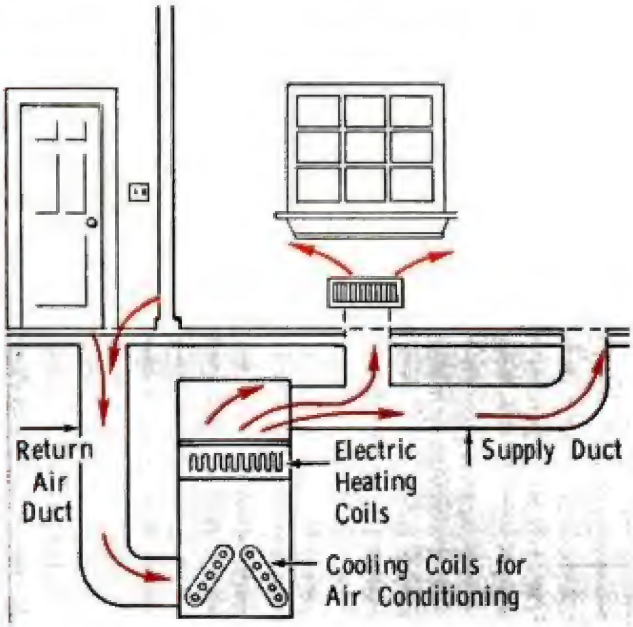
Gas heater—power vent



Firebox liner saves 25% fuel



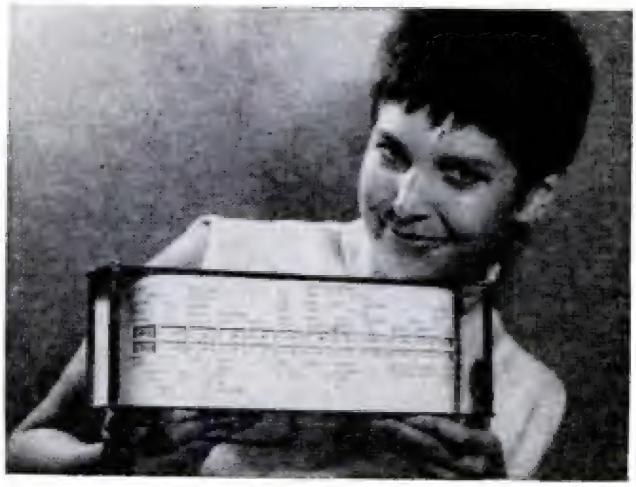
Electric heater—airconditioner



Escape Suit

Emerging from a simulated 450-foot dive, a test diver in Britain's Royal Navy wears an experimental pressurized suit that allows him to rise quickly to the surface without danger of the bends.

Designed for escape from submarines, the suit is filled with air to maintain a steady pressure on the body. The new suit can be decompressed on the surface.



Global Time

The correct time for any location in the world appears on the face of a new clock from Hamburg, Germany.

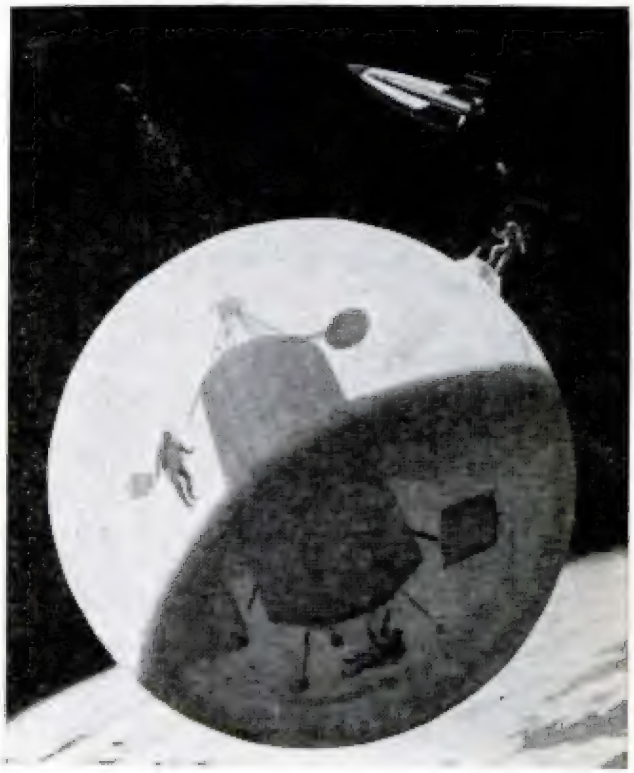
Called the Geochron, the unusual clock has a time scale that moves one revolution every 24 hours, indicating the hour in major cities.

Space Bubble

Plastic balloons could protect astronauts working outside of their spaceships. Similar to the Echo satellites in design, the balloons would be inflated in orbit and would form a cocoon around the work area.

The "bubbles" could be tethered to the servicing spacecraft, and astronauts would enter and leave through an air lock.

The concept was developed by Boeing Company and Air Force scientists.



3 GIANT STEPS TO THE MOON

Part 2

Hardware to launch our moon men involves tractors the size of half a football field; a building so big it breeds rain clouds inside; 40-story rockets —and most of it already is built.

By Clifford B. Hicks

WALK INSIDE our cavernous new moonport and you shrink to ant size. All visitors have the same reaction.

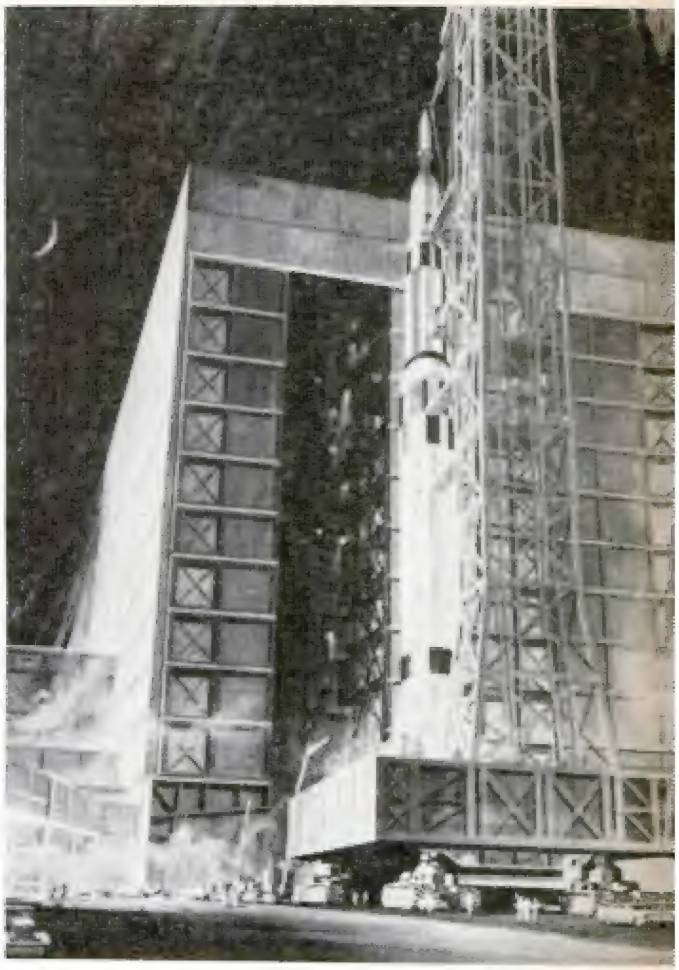
It's the largest building ever built. It could swallow the Pentagon and Chicago's Merchandise Mart, and still have room for smaller buildings. Its monstrous doorway could admit a building as tall as New York's towering Hilton Hotel.

Its size is a reflection of its mission. The building is designed for man's most ambitious undertaking—getting man on the moon by the end of the decade. Surprisingly, this modern wonder of the world, built on Cape Kennedy, Fla., is almost complete. By next February, for all practical purposes, the United States will have the facilities to launch a moon flight.

The moonport is being built at a fantastic pace. Three hundred men, in less than a year, designed the $1.2 billion facilities; ground was broken just 26 months ago. The architectural problems provided colossal headaches. Before the project is completed, an estimated 300,000 workers will be involved in the construction of the moonport and its space ships.

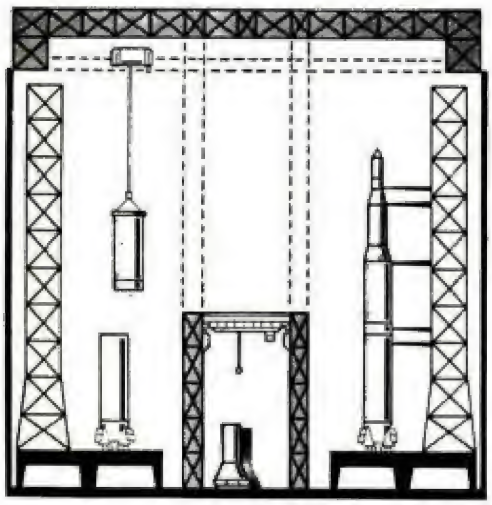
Four Apollo rockets will be born simultaneously in the building. The first "practice" rocket will be rolled out early in 1967, but the real target year is 1969. Consider what will happen on a memorable day that year:

A tractor half the size of a football field will crawl into the vast structure and lift on its shoulders a rocket more than three times the height of the Statue of Liberty, strapped to an even

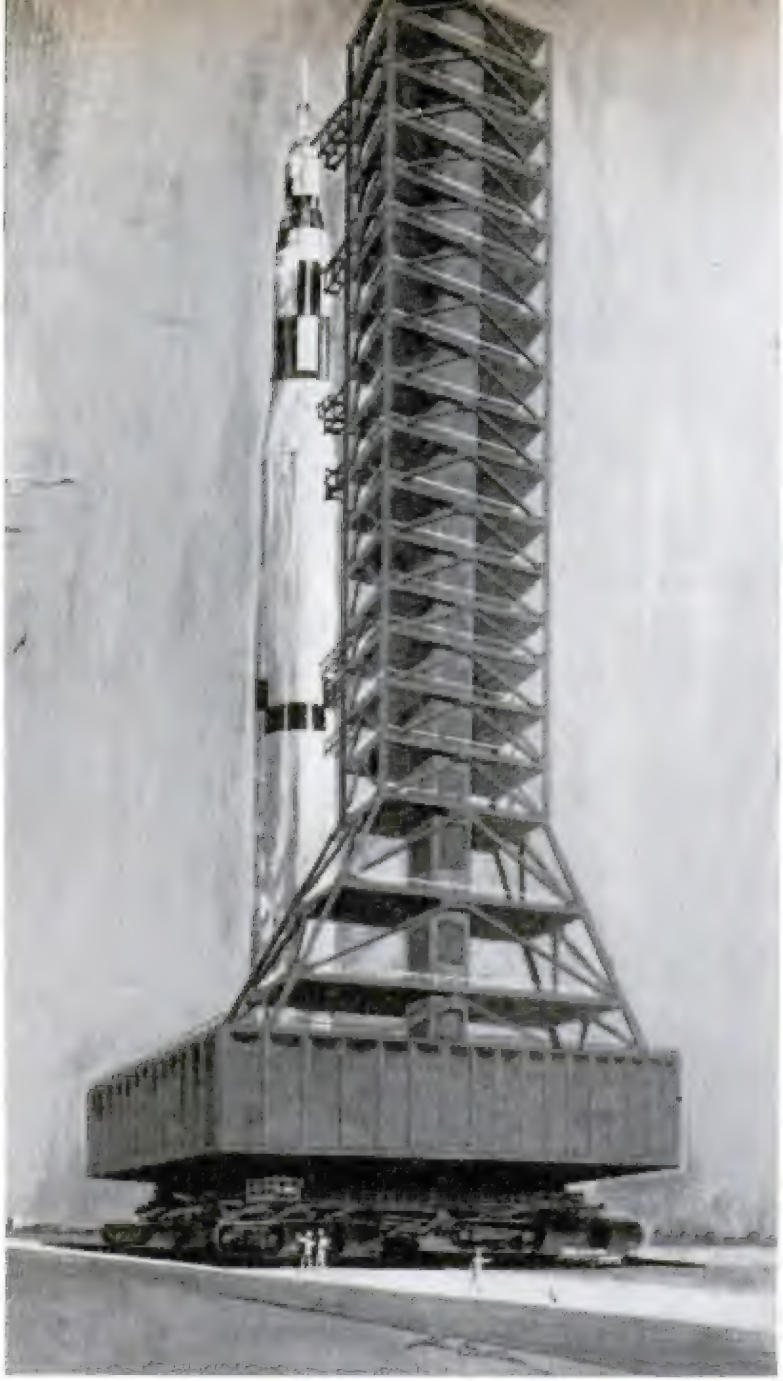


GIGANTIC MOON VEHICLE will be assembled vertically and moved to launch site in that position. Drawing (left) shows a derrick positioning the first stage

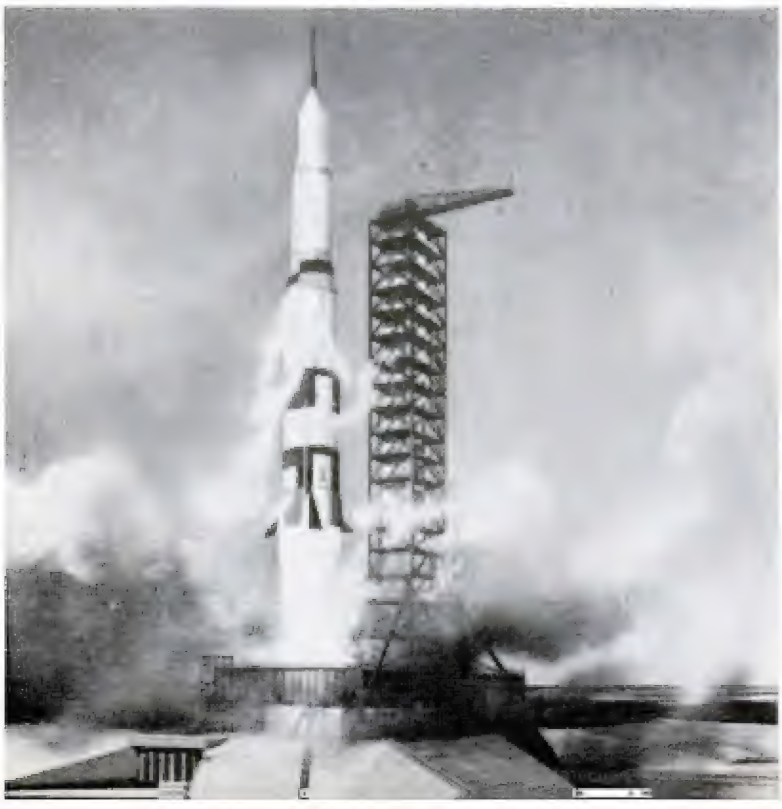
WORLD'S BIGGEST BUILDING, the Vertical Assembly Building (VAB), nears completion. It's 525 feet tall, 710 feet long; 515 feet wide, has doors 460 feet high



CAVERNOUS "VAB," shown in cross-sectional drawing, contains four high bays, each equipped to hold a Saturn V-Apollo vehicle and its mobile launching tower. Second bay area is seen through doorway



SNAIL-PACED TRIP of rocket and tower (right) to launch site is made aboard the crawler-transporter. Half the size of a football field, this fantastic machine can carry loads up to 12 million pounds



DESTINATION MOON. Blast-off will be an awesome sight as the Saturn V unleashes a thrust of 7.5 million pounds to lift off the pad a total weight equal to that of 2000 medium-sized automobiles

taller launching tower. It will ease this towering load through the tallest garage doors ever built; and it will crawl away at a snail's pace to a 5° ramp placed a little more than three miles away. As the tractor climbs the ramp, computers inside will sense the faintest sway of the 446-foot, 11.5-million-pound load and keep it as precisely balanced as a circus acrobat on a pole. Then the tractor will carefully deposit it over a great flame bucket.

The rocket then will accept its 5.5 million pounds of fuel and its 500 pounds of human cargo. At the fateful moment a button will be pushed 3½ miles away, and man will soar off to explore and colonize his solar system.

The monstrous structure that will give birth to the moonshot is called the Vehicle Assembly Building, or simply VAB. You can see VAB any Sunday between 1:00 and 4:00 p.m. You can also drive past three of the mobile launching towers, examine the two incredible tractors (one backs up the other) and drive past two completed launch pads.

And you'll see signs of the moonshot throughout the Cape area. The nearby town of Titusville proudly boasts that it is "The Gateway to the Moon," and the village of Oak Hill stakes out even more of the cosmos as "The Gateway to the Universe." You can snack on moonburgers, and you can watch the kids orbit the playground at the Satellite Christian Kindergarten and Day School.

VAB is 525 feet high, the equivalent of 52 stories (it is the tallest structure south of the Washington Monument), and it encloses a third more space than the Great Pyramid of Cheops.

It has to be big. "From this spaceport," says a NASA official, "we'll be able to orbit a 36-man space station with enough supplies for a year; to send a 45-ton spacecraft to the moon; and to launch a 30-ton ship to Mars or Venus."

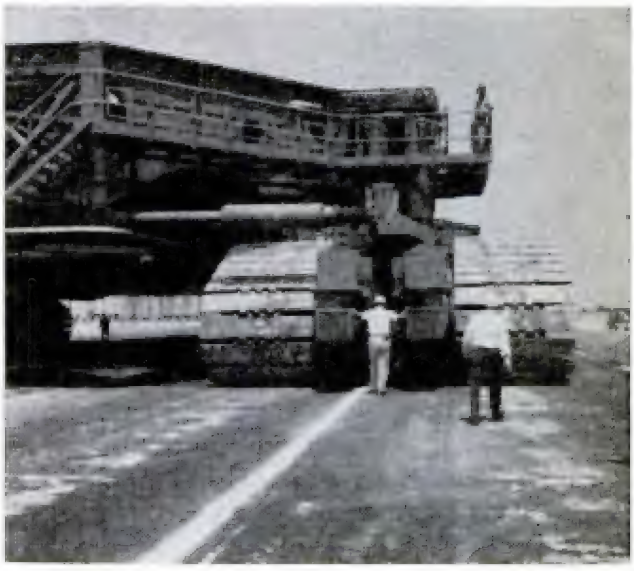
The airconditioning system could cool all the homes in a city of 15,000. It presented the designers with perhaps the strangest architectural problem ever: The building is so vast it could actually breed its own rain clouds beneath the roof. Only parts of the structure are airconditioned, and cool dry air from these areas, mixed with the humid, hot Cape air, could produce thunderheads. Showers would drench the scientists and their precious rockets, thus defeating the very purpose of the building. Supplementary ventilation, it is hoped, will solve this.

Just holding up such a building in the shifting Florida sands presents problems. The building rests on 4225 steel stilts, each 16 inches thick and 160 feet long, that reach down to bedrock.

Holding the building *down* is a problem, too. To keep it from taking off like a box kite, it is anchored solidly to its forest of buried stilts and is designed to withstand 125-mph hurricane winds.

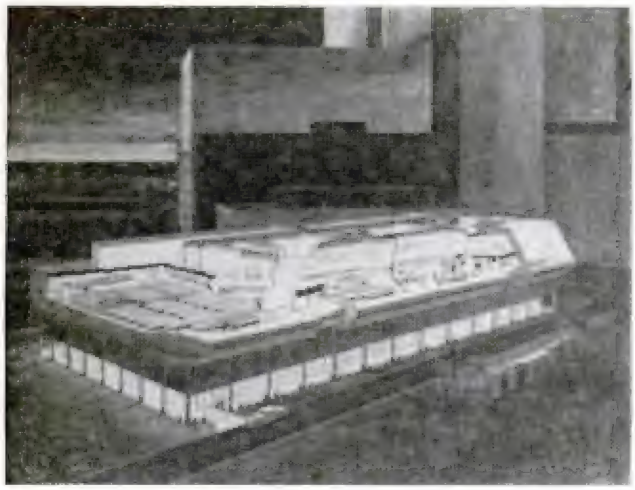
The purpose of VAB is to provide a controlled environment in which huge but delicate rockets can be assembled. All

LAUNCH PAD, shown under construction, has ramp (far side) with a gentle 5° rise. This is a critical stretch for the delicately balanced moon rocket



GARGANTUAN TRANSPORTER has four pairs of crawlers like those shown. Each crawler has 47 separate shoes and each shoe weighs more than a ton

MERRITT ISLAND MOONPORT was laid out on land reclaimed from swamps. Rattlesnakes still abound



MEN LOCATED CLOSEST to astronauts during launch are in the Launch Control Center, a beehive of computers, giant TV screens and other electronic gear

DARK LOUVERS are electrically controlled and can be positioned to cut down glare of the sun and provide operators with a clear view of the launch area

manned rockets of the past were built atop their launching pads, but early in the moonshot planning it became obvious that Saturn V would be so complex that it would have to be assembled indoors. The only way to do this is to move the launching pad itself inside a permanent building, assemble the rocket on it, and then move the pad out again.

VAB is divided into four identical high-bay sections and one low-bay section. The various stages of Saturn V will arrive on barges at a nearby pier. From there, they will be hauled horizontally on a trailer to the low-bay area, where they will get a preliminary checkout.

Meanwhile, one of the two huge tractors will ramble over to a nearby parking lot, fetch the particular rocket's own launching pad (called a mobile launching tower) and deposit it in a high bay.

The launching tower is considerably bigger than the rocket itself, and in some ways more spectacular. Measuring 446 feet high, it looks like some futuristic oil rig. Its two-story base is built and compartmented like a battleship, and holds banks of computers whose long, wiry fingers will probe each of the thousands of vital organs of the Saturn rocket as they are installed, providing a running physical examination. One NASA expert estimates the base of the tower holds enough electrical wire to reach to the moon.

Running through the steel framework of the tower is a high-speed elevator, the type found in skyscrapers. It provides access to each level, and a means of escape should fuel spill during countdown.

After this self-contained tower is deposited inside VAB, a crane in the peak of the building will swing the Saturn V booster onto the launching platform. Then the other two stages will be stacked like blocks atop the booster, with the moonship balanced on top. The crane that provides all this muscle is so sensitive that it can raise a 250-ton load as little as ½-inch.

To enable the technical experts to swarm over the rocket at any level, all bays have five mobile work-platforms, each two or three stories high, that end in semicircular cutouts. The 100-ton platforms move in and out like suspended file drawers, mating to form buildings inside the building.

(Please turn to page 228)

Tank Cat

Discarded jet fuel tanks bound together with torsion arms and powered by a sail on a tripod mast became the major hardware of a homemade catamaran.

A sheet of canvas—perforated so it won't act as an airfoil—makes the deck. The torsion arms allow the hulls independent movement with enough rigidity for control, and the tripod mast distributes the load of the sail evenly. Thin aluminum fins are installed on the keel side of the tanks for stability.

The maker, Louis Vernon of Pennsylvania, has dismantled the 19-foot catamaran and transported it on the roof of a Volkswagen. He has designed smaller 15 and 13-foot catamarans as well.

Free-Power Radio

Place this set in sunlight and you never spend a cent operating it. Solar cells in the handle keep the Zenith Sun Charger working and charge the built-in nickel-cadmium batteries for nighttime listening.

Sharp Curves

A knife sharpener using grinders mounted in a cross position will sharpen even the serrated edges of carving and bread knives.

A spring keeps the rotating grinders of the Ikos knife sharpener pressed to the blade regardless of its curves, says the Belgian manufacturer

SUB-MINIs

Those Mighty Midget Cameras

Try a tiny camera that fits in a shirt pocket. With some know-how you'll make good pictures

By Bob Berger

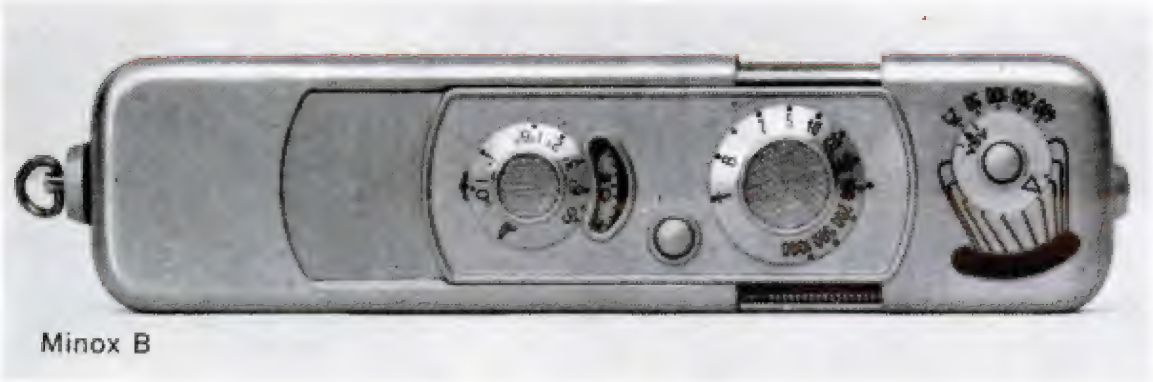
TWENTY-FIVE YEARS AGO, you probably didn't own a subminiature camera (one using film smaller than 35-mm) unless you also carried a code number, a Luger automatic and had a secret radio transmitter hidden in your attic. Tiny, precision cameras were strictly cloak and dagger items. Not so today. In fact, subminiature snapshooters are clicking away at a record rate.

From a bumper crop of tiny cameras, *PM* selected some of the more popular models—those you are likely to find stocked at the local camera shop—and put them through their paces.

Seven sub-minis were tested:

The Minox B, the granddaddy of all tiny cameras, is made in Germany, and is

Minolta 16 II



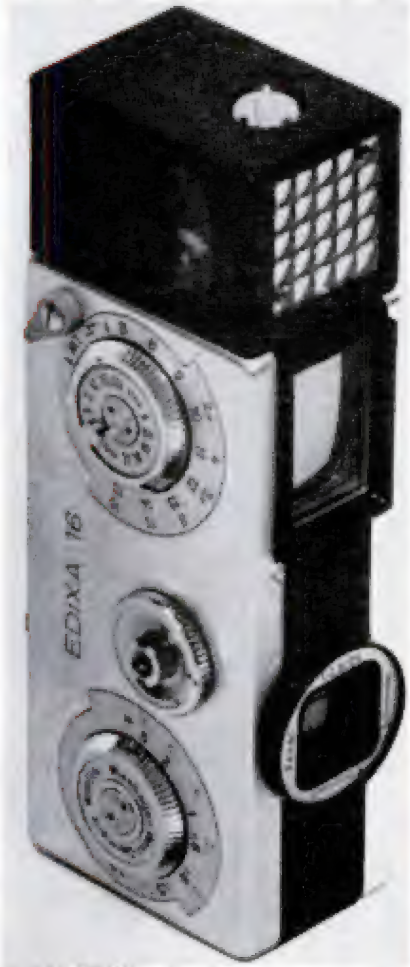
Minox B

Rollei 16

EXCLUSIVE PM PHOTOS

Minolta 16 CDS

Tessina



Edixa 16

Yashica 16 EE

not much larger than a man's index finger. Shutter speeds range from ½-1/1000 sec. Lens aperture is fixed at F:3.5. Film is available in either 36 or 50-exposure cartridges. Special features include built-in filters, measuring chain for close-ups, built-in coupled exposure meter, and bright line viewfinder with automatic parallax correction. The price is $149.95.

The Minolta 16 II, 16 Ps and 16 CdS are Japanese-made submini's that give 20 exposures on 16-mm film. The 16 II has a fixed focus F:2.8 lens and shutter speeds to 1/500 sec. The 16 Ps is equipped with a fixed focus F:3.5 lens and a "Weather Dial" exposure control. A two-way shutter speed selector sets the shutter at 1/100 sec. for daylight snapshooting or at 1 30 for flash pictures. The 16 CdS has, as its name indicates, a cadmium sulphide electric eye that automatically adjusts the diaphragm setting for the four-element F:2.8 lens. A green signal shows in the bright frame viewfinder when there is sufficient light for picture making. The 16 II costs $37.50, 16 Ps is $25.50, and the 16 CdS is $79.50.

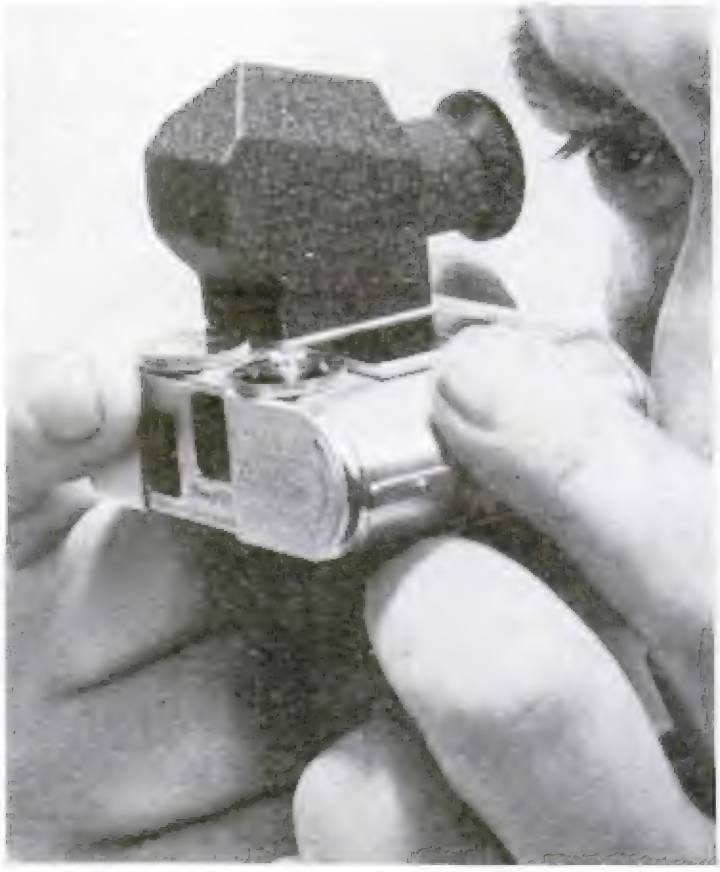
Bearing a name familiar to most camera buffs, the Rollei 16 uses an 18-shot cartridge. The lens is a Tessar F:2.8; exposure is set automatically, but manual control is possible. A go-ahead green dot is incorporated in a luminous frame viewfinder corrected for parallax. The camera sells for $179.50.

The Edixa 16 has a Xenar F:2.8 lens, and an automatically programmed shutter and diaphragm using the light value system. Speeds range from 1/30-1/500 sec. Cartridges are loaded with 21 exposures. It is priced at $99.50 with meter, or $79.50 without.

The Yashica 16 EE makes 20 exposures on 16-mm film. The camera has an F:2.8 fixed-focus lens, and features thumb-wheel film advance and electric eye exposure setting. The price is $55.

Rounding out the group is the Tessina. By our own definition, it is not a submini because it uses 35-mm film. But its light weight—5½ ounces, and small size—2 x 2½ x 1 inches, seem reason enough to include it. The Tessina boasts a number of unusual features: spring motor film advance, reflex viewing, and a negative two or three times larger than most of its competitors. Shutter speeds are from ½-1/500 sec. The lens is a 25-mm F:2.8 Tes-

(Please turn to page 243)



SWISS-MADE TESSINA is shown here with an accessory pentaprism viewfinder. The finder sells for about $40 and gives a 6x magnification for easier focusing. An 8x magnifier is also available for $19.95

PROCESSING TIPS

First of all, your darkroom must be clean; dust is the archrival of the subminiature photographer. A tiny, unseen speck that settles on a negative will show up in the enlargement as an aspirin-sized white blob. But dust is pesky stuff; even after a thorough cleanup, you may find that you are still getting spotty prints. In such a case, it's likely that static electricity is the real culprit. Try grounding your enlarger to a water pipe, and use an antistatic brush (available at most photo shops) to clean the negative.

Development of submini film isn't difficult, though care is needed in controlling solution temperatures. Your best bet is to follow the manufacturer's directions. Generally, if developer, stop bath, hypo and wash water are kept at 68-70° F., you'll get good results.

WEATHER DIAL on Minolta 16P uses symbols for common lighting conditions. Exposure is set by turning pointer to the proper symbol

ROLLEI 16 has excellent luminous frame viewfinder, handy milled wheel for setting distance scale which is visible through window

RIGHT ANGLE VIEWFINDER on Yashica 16 EE is especially handy for candid shots of kids and even adults who tend to mug for your camera

TOP SHOT was taken with Minolta, middle picture with Tessina. A Rollei 16 made bottom shot. All enlarged well to 8 x 10

The importance of precise temperature control makes an accurate thermometer an absolute must. So-called process thermometers are not expensive and are consistently correct within one degree.

All solutions should be filtered, either through laboratory-type filter paper or a tuft of cotton placed in a funnel. Even the wash water can deposit sediment which may become imbedded in the film emulsion. One way to beat the problem is to bathe the film in hypo eliminator after it is thoroughly fixed, then simply soak it in several changes of filtered water.

Excessive grain can ruin film shot with even the best submini. Expanded grain is often the result of long development and washing times. With this in mind, try to choose a fine-grain developer having a reasonably short working time and use hypo eliminator to cut down wash time. After washing, don't sponge or squeegee the film, instead, dunk it in a wetting agent and hang it up to dry.

Once you get really hooked, you'll probably want to buy darkroom equipment specifically made for submini work. Various developing tanks are available, as are special enlargers. These are usually of the condenser type and are fitted with short focus lenses for big blow-ups. If you prefer, you might buy a 25-mm lens for your present enlarger and use that for submini negatives. Other than the tank, enlarger and plenty of perseverance, there's nothing else you'll need to develop and print submini films. Happy processing.

Small-Batch Readymix You Haul Yourself

Small concrete orders are such a nuisance that most readymix suppliers tell you to hoe up your own. But not the Trailer Mix Concrete outlets, now spreading across the Western states. They're in business strictly for small-batch pour-it-yourselfers. Their setup has a hopper car that rolls under three big bins to catch regulated amounts of gravel, sand and cement. The car then dumps into a mixer which, in turn, dumps into a special trailer hitched to the customer's car (left). At the pour site a hydraulic system jacks up the trailer to discharge the load (right).

Paper Decoys

Lifelike goose decoys are easily made from paper cutouts pasted onto cardboard boxes.

Available in Canadian Honkers, Blues and Snow Geese, the bodies and heads are printed on gummed paper. These sheets are laid over a cardboard box, cut out and assembled. They can be waterproofed by coating with a dull varnish.

Each set includes eight sentinels and four feeders, and they are priced at $4.95 from Decoys, Box 66, Rosemount, Minn.

X-ray of 2000-Year-Old Mummy

X-ray above shows the skull of a mummy at the Smithsonian. Films of the encased body (right) were made at a Navy lab with a powerful machine ordinarily used for examining rockets. The X-rays revealed the remains of a man of 25 who lived during Cleopatra's time.

Bottoms Up Down Under

THINGS GOT A BIT OUT OF HAND when the Australian Catamaran Assn. set out to obtain a water ski picture to publicize the speed and power of the Big Class C cats. Since the camera was loaded, the photographer just kept shooting and came out with this spectacular tip-over series—which first appeared in the United States in *One-Design Yachtsman*.

1...POWERFUL CAT with 300-square-foot sail was able to pick up skier from a deep start and pull him to a speed of over 20 mph

2...FUN STARTED when the lee hull went under. As helmsman attempts to free sheet, trapeze man seems to shrug his shoulders

3...UP, UP AND AWAY, with trapeze man now taking a dip off bow as the helmsman glances frantically around for a ladder

4...**GERONIMO!** Mast hits the water, tossing the hapless helmsman down into the middle of 300 square feet of expensive sail

5...**JOLLY GOOD CHAT** aboard upsidedown cat was undoubtedly not type we could print. The boat, incidentally, wasn't damaged

Brain Control by Radio

Will entire populations be controlled some day? Already, electrical impulses to the brain can halt a charging bull, quiet a raging monkey or make a sedate woman act flirtatious

By John A. Osmundsen

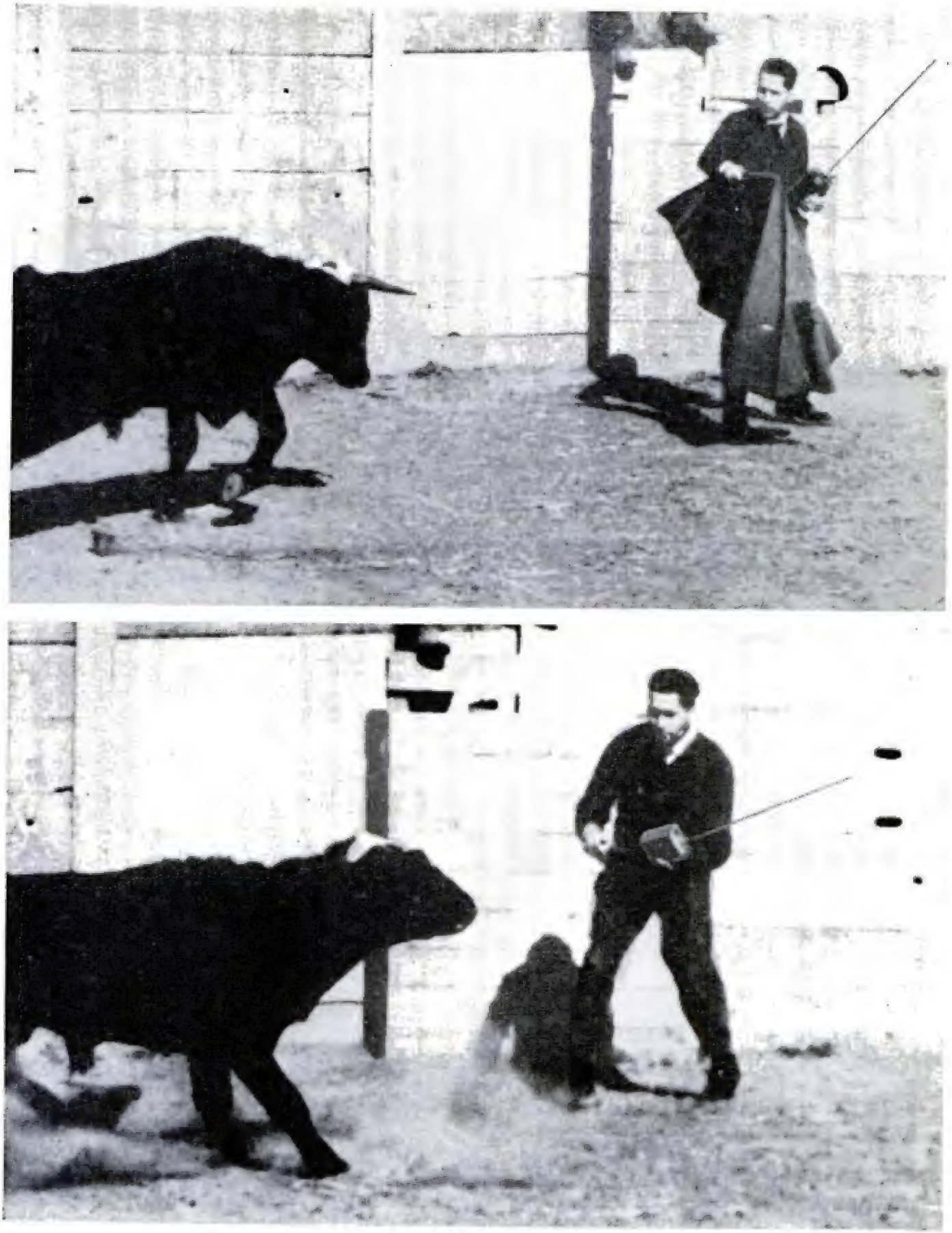
SPECTACULAR SUCCESS in recent experimental attempts to control the social behavior of animals—and of people—by electrically stimulating their brains has led some persons to ask, very soberly, questions that seem to come right out of the annals of science fiction.

These questions have to do with the feasibility of achieving robotlike control over a population of human beings by electrical stimulation of the brain, say, with radio waves that would surround them and secretly direct their thoughts, desires and actions.

Such remotely imposed influences on the brain might be as innocuous as simply producing feelings of happiness and pleasure in a population or as insidious as motivating mass behavior for political purposes. But moral and legal questions aside, the technical ability —at least on an individual basis—exists. The key is ESB—electrical stimulation of the brain. An expert in the field says that "functions traditionally related to the psyche, such as friendliness, pleasure or verbal expression can be induced, modified and inhibited" through ESB.

In animal experiments, for example, weak currents sent through wires implanted in selected regions of the brains of cats and monkeys have permitted scientists to "play" them "like little electronic toys." The animals opened and closed their mouths, stood up, turned around, climbed, fought, hid, yawned, licked, slept and mated —all on electronic command.

What was probably the most spectacularly convincing experiment of this sort involved a Spanish fighting bull in whose brain some 20 electrodes had been implanted. On the day after the operation, a scientist playing the role of bullfighter, armed with only a cape and a radio transmitter, stopped the bull in full charge by sending



BRAVE BULL VS. BRAVER SCIENTIST. A tense Dr. Jose M. R. Delgado stops the angry animal in its tracks with a quick signal from hand-held transmitter

STRANGE THINGS HAPPEN to monkey's eyes when current is applied to electrodes in brain. Compare size of constricted right eye (photo at right) with normal eyes (left). Effect comes from stimulation of specific brain region

a radio signal to the creature's caudate nucleus—a region of its brain that inhibits aggressive behavior. Stopped within 15 feet of the man, the bull suddenly turned to the right and trotted off in response to a second radio stimulation, this time to a motor neuron that directed such movements.

The behavior of humans, too, has been modified in a variety of ways through ESB. They have been made to feel pleasure, anxiety, friendliness and sexual attraction. They have experienced total recall of past experiences and a sort of hallucinatory "double consciousness" of real and unreal perceptions simultaneously.

The state of being doubly conscious during ESB has been described as feeling as if a tape recorder or movie film, sound track and all, were running in one's brain and playing back a previous experience—such as attending a ball game or concert—while at the same time the individual is perfectly conscious of everything that's going on in the present.

Some persons under ESB have temporarily lost the ability to think or to express themselves. And some have suddenly upped their verbal output as much as fivefold without any loss of continuity or intelligibility.

An 11-year-old boy who underwent implantation of electrodes in his brain for diagnosis and treatment of epilepsy increased his verbal output from 17 words every two minutes to 88 words. In addition, he seemed to be especially optimistic and friendly toward his doctor during stimulation.

ESB produced a different effect in an attractive 32-year-old epileptic woman. Usually reserved during interviews with her doctor, she became visibly altered during stimulation of her brain. She held her doctor's hands, expressed fondness for him and began to act flirtatiously.

Judging by the results of such experiments, it seems less science fiction than fact that it might be possible one day to control the general behavior of an entire population. Asked about this, one of the foremost authorities in this field said: "Fortunately, that prospect is remote, if not impossible, not only for obvious ethical reasons, but also because of its impracticability."

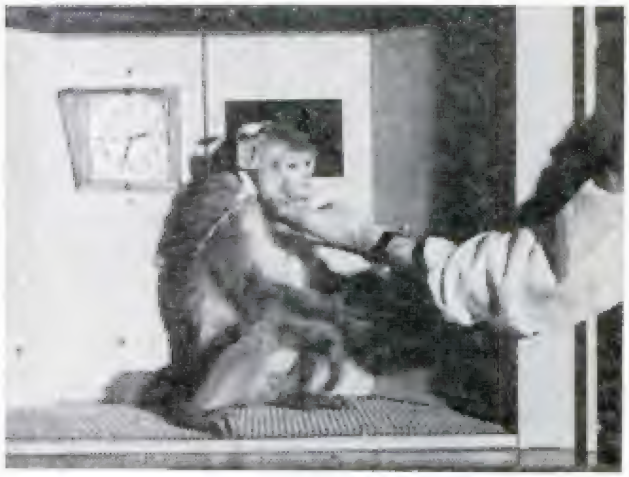
Those are the words of Dr. Jose M. R. Delgado of Yale University's School of Medicine, where he has been studying the effects of ESB on animals and humans for the past 15 years.

The physical variability of brain structure among different persons, Dr. Delgado explains, would make it almost impossible to place an electrode in precisely the same spot in a large number of brains.

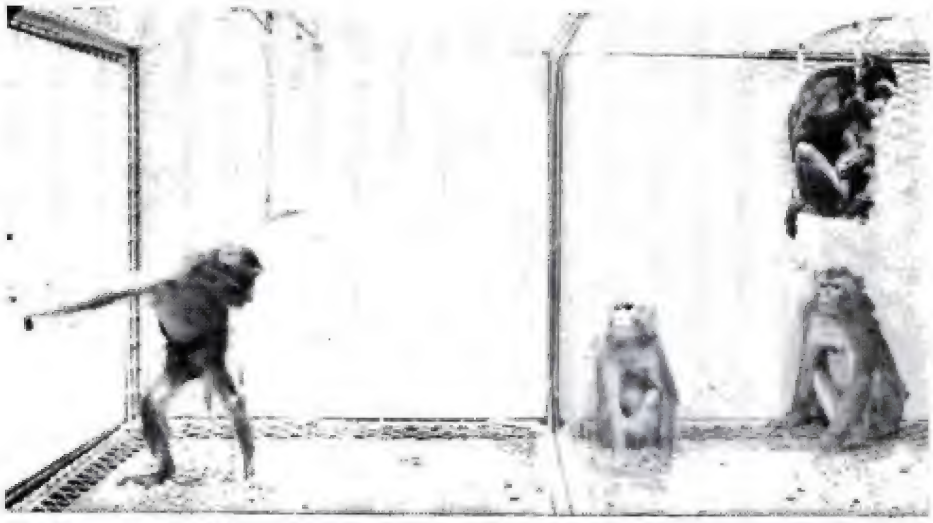
There is also great functional variability

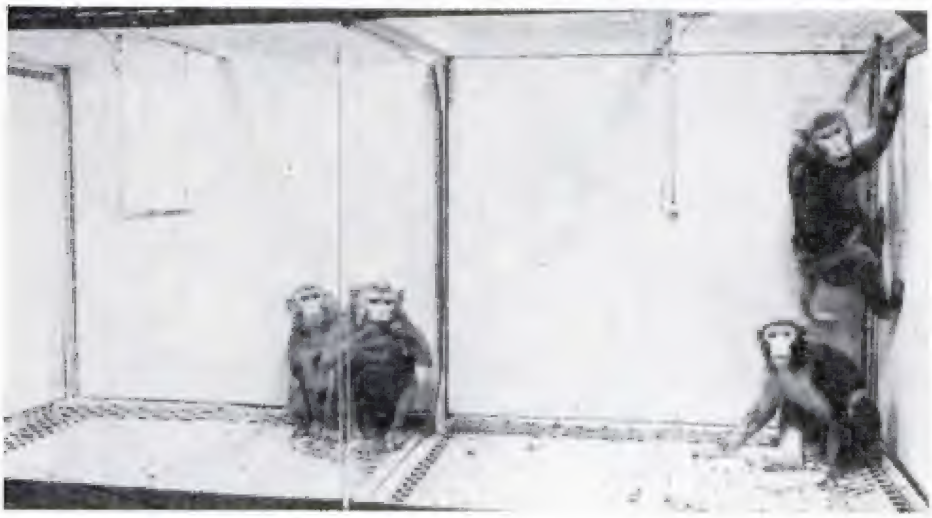
(Please turn to page 222)

OPPOSITE EFFECT results from stimulation of another site. By varying current, scientists can control animal's pupil like the diaphragm of a camera



ANGER BECOMES APATHY under stimulation (right). Wire leading to electrode can be seen in lower photo. Electrodes are implanted under anesthesia and are said to cause no pain or damage of brain tissue





MEEK FEMALE has learned that she can change bully (sitting in corner of cage) into nice guy by pulling lever that controls radio signal. She looks at him while operating lever, which is unusual, say researchers. A lower-ranking monkey ordinarily doesn't look straight at the boss for fear of retaliation. When not being stimulated (below), the bully reverts to type and, with nothing better to do, tries biting his own hand.

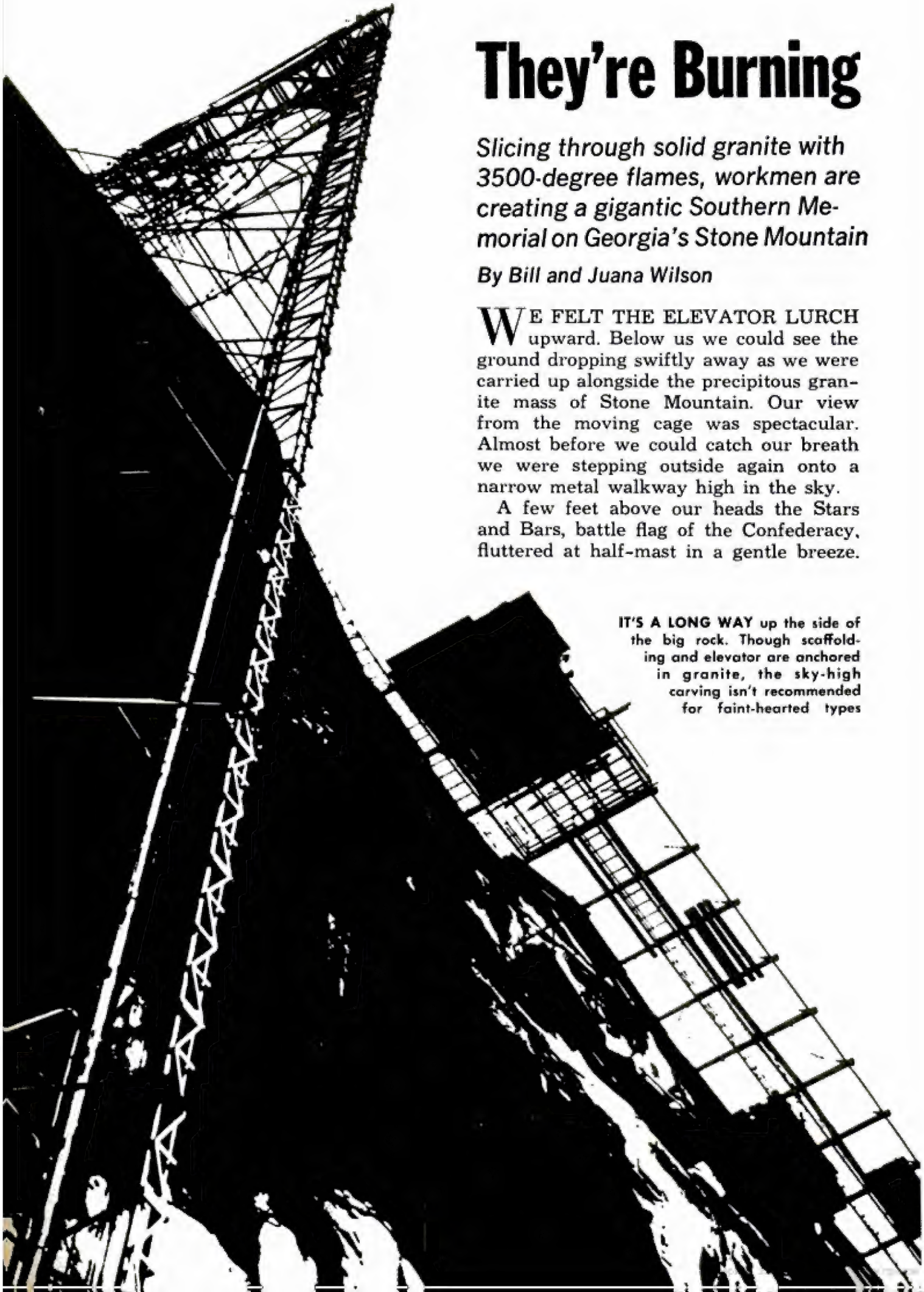
They're Burning

Slicing through solid granite with 3500-degree flames, workmen are creating a gigantic Southern Memorial on Georgia's Stone Mountain

By Bill and Juana Wilson

WE FELT THE ELEVATOR LURCH upward. Below us we could see the ground dropping swiftly away as we were carried up alongside the precipitous granite mass of Stone Mountain. Our view from the moving cage was spectacular. Almost before we could catch our breath we were stepping outside again onto a narrow metal walkway high in the sky.

A few feet above our heads the Stars and Bars, battle flag of the Confederacy, fluttered at half-mast in a gentle breeze.



IT'S A LONG WAY up the side of the big rock. Though scaffolding and elevator are anchored in granite, the sky-high carving isn't recommended for faint-hearted types

a Memorial into a Mountain

As we eased gingerly away from the elevator, burdened with cameras, flash equipment and a tape recorder, my wife inquired about the flag.

"It's at half-staff in memory of a friend of ours," Pete explained, "A photographer. He was killed here at Stone Mountain a couple of weeks ago."

Thus, 35 stories above the ground and with considerable misgivings about our assignment, we Illinois Yankees began unlimbering our equipment to do the story of a Confederate mountain carving 16 miles east of Atlanta, Ga. Wearing hard hats and equipped with earmuffs to drown out the roar of the big jet torches, we watched a four-man crew literally burning a Southern lady's dream into the granite face of Stone Mountain.

Fifty years have passed since Mrs. Helen Paine, president of the Atlanta chapter of the United Daughters of the Confederacy, first approached sculptor Gutzon Borglum with an idea of having a small bust of General Robert E. Lee carved out of the mountain. Borglum, who never thought "small," conceived a colossal procession of Confederate soldiers and officers, both afoot and on horseback, marching around Stone Mountain's granite base. It would require 10 years and $3 million to finish the job, he estimated.

Arriving at the memorial site in 1918, Borglum began working on his models and conducting experiments to determine the effects of dynamite and drills on the stone. By night he used a giant slide projector to enlarge a pen and ink sketch of his creation against the side of the sloping mass of granite. Men suspended on ropes

BIG CUTTING TORCH roars as it burns into rock, making earmuffs necessary. It's like a small jet engine, burning mix of kerosene and liquid oxygen

HEADS AND FORMS of heroes and outline of horse begin to emerge from the north side of the mountain. Some of the carving dates back to the late 1920s

DOME-SHAPED STONE MOUNTAIN is said to be the world's largest single chunk of granite, weighing an estimated half billion tons. It's about 5 miles in circumference, covers 583 acres and rises almost 700 feet above surrounding terrain

ORIGINAL MODEL OF MEMORIAL by sculptor Augustus Lukeman includes (starting at left): Jefferson Davis, Robert E. Lee, "Stonewall" Jackson and a color bearer. On full-scale carving, the distance from Lee's head to his horse's hooves is 138 feet

used white paint to copy Borglum's projected drawing onto the mountainside. By 1924 the sculptor had finished carving the first head of General Lee. To celebrate the occasion he served an "unveiling" dinner to 20 notables seated at a banquet table on the general's shoulder 350 feet above the surrounding terrain.

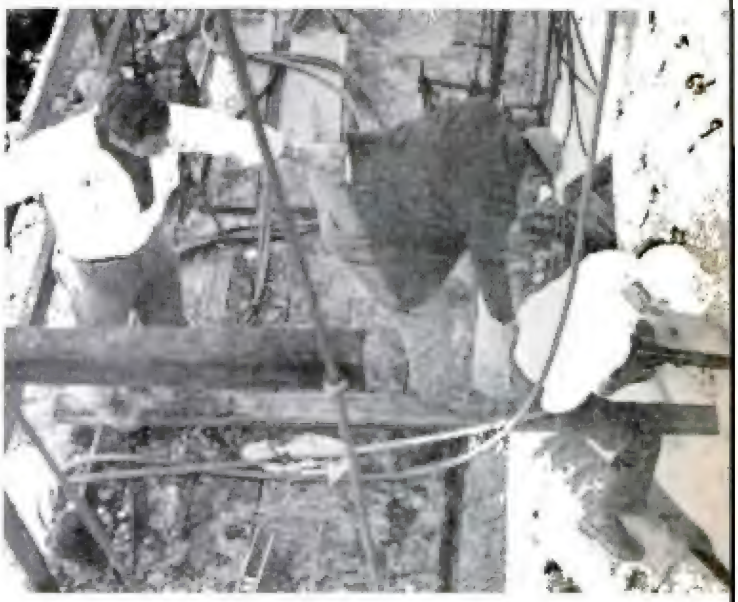
But Borglum was a temperamental genius, and a rift developed between him and the Stone Mountain Confederate Memorial Assn., which had employed him. In March, 1925, he was fired from the project and hurriedly left the state before a warrant could be served charging him with the destruction of his models and sketches.

Sculptor Augustus Lukeman was next engaged by the association to complete the memorial. Upon arriving at Stone Mountain, Lukeman discovered that his predecessor had committed a blunder in transferring his design onto the mountainside. This resulted in a tremendous distortion of the figures when viewed from different angles. Nothing more could be accomplished until the completed head and shoulders of General Lee were destroyed. Lukeman proceeded to dynamite away Borglum's work and substituted his own design of Jefferson Davis, Robert E. Lee and Stonewall Jackson, all mounted on horseback.

Early in 1928 a new head of Robert E. Lee, this time Lukeman's, was unveiled, and the rest of Lee's figure and that of his

TRIM BEARD of General Lee is measured before a smoothing operation. Standard engineering methods are followed in plotting dimensions on the rock wall

SMALL PNEUMATIC TOOLS are used to smooth the surfaces of General Jackson's mouth and left ear. The heroic heads are more than 15 feet in height



TEAMWORK IS VITAL to safety—man straddling plank is steadied by two linked buddies. Numbers on rock face show depth pilot holes are to be drilled

horse were blocked out. When completed, the carving would measure 138 feet from the top of Lee's head to his horse's hooves. The general's sword would be 58 feet in length, and, if detached, would weigh approximately 100 tons. The ears of Traveler, General Lee's famous horse, would stand 12 feet high.

By midsummer 1929 funds for carving the memorial were exhausted, and work on the mountain was discontinued. And so it remained for 35 years, its cables and stairways falling into ruin. Lukeman returned to his home in New York where he died in 1935, never losing hope that someday he would return to Stone Mountain and complete his unfinished masterpiece.

In 1958, Georgia's legislature appointed a new Stone Mountain Memorial Assn., to be accountable to the state, and authorized the purchase of 1950 acres, including all of Stone Mountain, for just under $2 million. A bond issue was arranged, and nine prominent sculptors were invited to submit designs. In 1963, Walter Kirtland Hancock of Gloucester, Mass., whose plan incorporated the completion of Lukeman's unfinished work, was chosen for the job.

By the following year workmen were busy once again at the memorial site. First they erected the world's tallest outside elevator, 350 feet in height, anchored firmly to the granite mountainside. New scaffolding, suspended on cables from the

(Please turn to page 218)

Life That's Made to Order

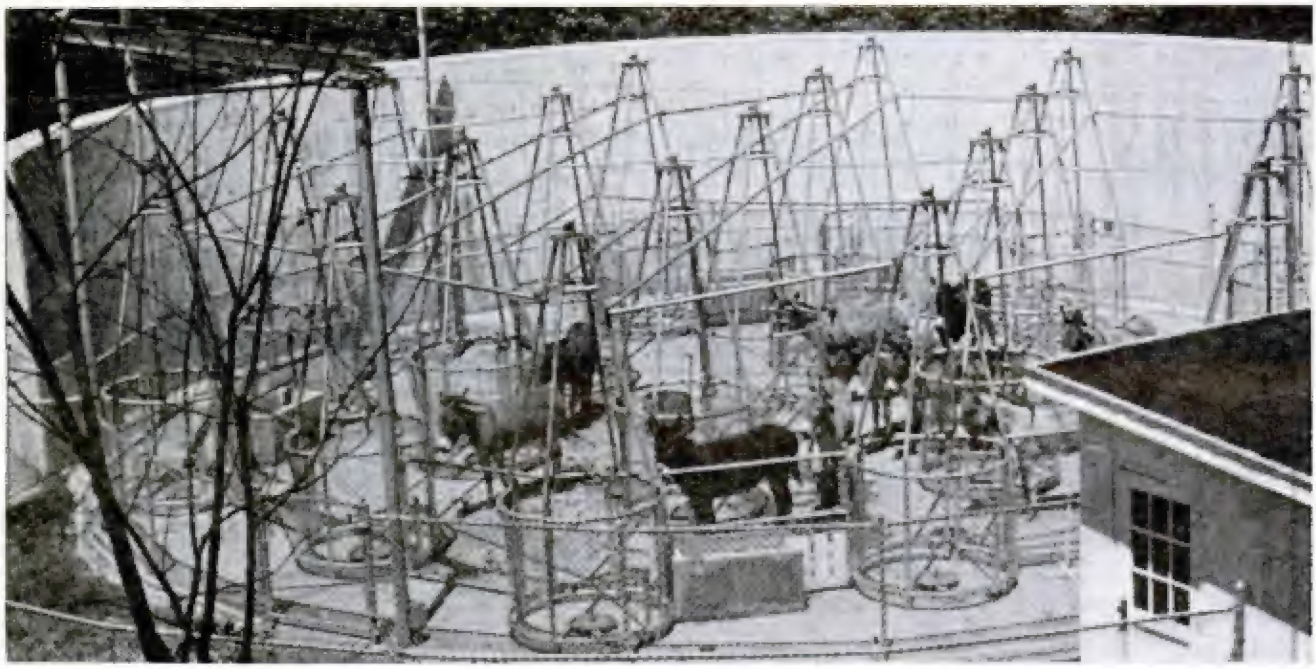
By irradiating living tissue, scientists at a unique agricultural laboratory are producing forms of life suited to man's special purposes.

By Arthur Whitman
Photos—Kurt Gunther

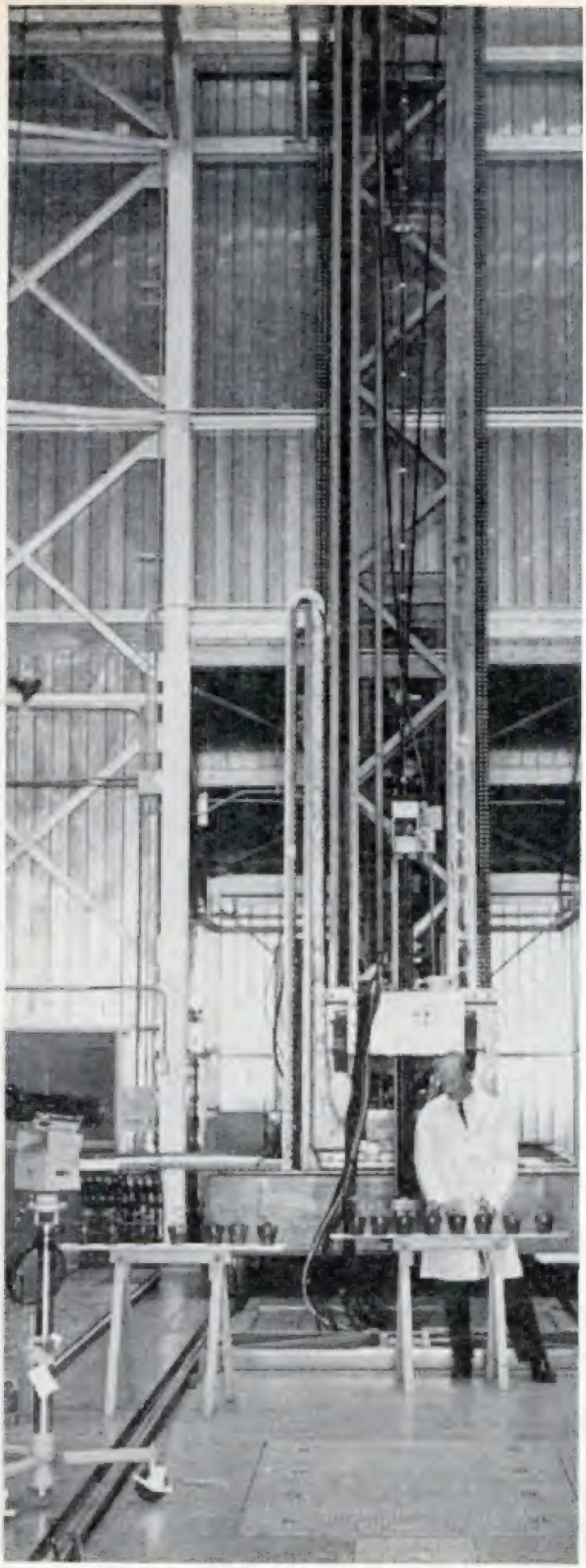
IT LOOKS LIKE A PLEASANT FARM on rolling pastureland, spattered with up-to-date buildings that gleam in the sunlight. But, in the sterile corridors, you'll find a handful of white-coated men, who, obviously, are not farmers. They are quiet, friendly scientists who—only a generation ago—might have been depicted as horror-movie madmen. For they are placidly engaged in twisting and changing the course of nature—forcing the hereditary factors in living things to do what they wish them to do in order to make them more useful to mankind.

"Nature's a lovely lady," explains a spokesman at the Atomic Energy Commission's Research Laboratory, operated by the University of Tennessee. "But I guess that like all gals, she's slow about some things and strong-willed about others. We're trying to help her see things our way."

In past years, the "Ag Lab," under the direction of Dr. Nathan S. Hall, has tickled nature into producing such amenities as some of the world's best cattle and poultry feeds. To untrained eyes, these look very much like any other alfalfa or hybrid corn you might see. Stems are a little greener, grains a trifle plumper, that's



IRRADIATION PAD at AEC's University of Tennessee laboratory is used to expose animals. Sources are imbedded in concrete; "hairpin" stalls can shield some parts, expose others. Burros are used because weight distribution is similar to humans'



ROOTED CUTTINGS of plants are set up for bombardment by fast neutrons. Reactor is in pool below table. Progress is monitored by TV when source is exposed

NEW VARIETIES of ornamental plants are produced by irradiation. Fast neutrons can create unique colors, shapes or sizes never before seen in nature

BURRO SUBJECTS show some effects of radiation. Two-toned fellow sports white skin from which hair has fallen due to dosage. Scientists explore metabolism

COLOR AND FORM of irradiated chrysanthemum cuttings were permanently changed by mutation, creating new varieties, as shown here. The "Sport" at left bred a brand new variety of flower, right

DR. THOMAS OSBORNE gathers the seed from cotton left to winter. Seeds of disease-resistant American, and Egyptian long staple varieties, are irradiated in attempt to produce desirable cross

LEAF MARKINGS and shapes can be changed by irradiation, in plants that normally refuse to produce "sports" in Nature. Here's an example of some leaf characteristics changed by fast neutrons

WASPS appear to adapt themselves to radioactivity. Some select radioactive mud for nests. The lab's Dr. Alvin Shinn is studying them to see how they do it

all—except that the plants contain as much as 35 per cent more nutrients than their direct ancestors did, a factor of incalculable commercial value to stockmen and farmers.

The changes were produced by irradiating seeds and plant cuttings with gamma rays. This affects the genetic structure and tends to produce mutations at a much faster rate than would occur naturally. "You can see how slow mutant production is in Nature by thinking, say, of the number of human midgets alive at any one time," says Dr. Hall. "In a world population approaching four billion, there may be a thousand or so midgets living at any time. We're able to produce scores of similarly drastic mutants almost at will. All we have to do is expose a large enough plant population to radiation."

Books have been written about the manner in which radiation affects living things. Ever since Hiroshima, the public has had a pretty good idea about the damage that gamma rays can inflict on cells, changing their reproductive characteristics drastically; sometimes producing rampant growth resulting in cancer. Frequently, however, more subtle changes occur in genes subjected to radiation. These microscopic controllers of growth determine every factor in your size, shape and color. It has been determined that one single gene determines whether a person will be white or negro. Genes are the targets of the scientists now busy with this work.

Mum colors never seen before

Today, among a host of other plant projects, the lab is busy developing new ornamental flowers and shrubs. A typical experiment is being carried on by horticulurist Dr. John E. Love, who is taking rooted cuttings of established chrysanthemum varieties that never produce "sports" naturally, and bombarding them with fast neutrons by irradiation. An incredible variety of resulting mutants shows all sorts of new characteristics—everything from gorgeous, eye-popping new colors to stems so weak they can't support their own foliage, let alone blossoms. Those with desirable characteristics are propagated again, crossed with each other as necessary, and so on, until a planned goal is reached. Results of a year's work to date: four new mums in colors never seen before.

A longer-range plant experiment is an attempt by agronomist Dr. Thomas S. Os-

(Please turn to page 210)

ANIMAL EXPERIMENTS include study of way glucose is metabolized in brain of Burros. Brain blood is drawn from an irradiated subject, above

CALF TIED to tip table is prepared for operation to implant a plastic tube to an internal organ. Isotopes are placed in organ; reactions are then studied

borne to establish a new variety of cotton. For over 150 years, there have been two dominant cotton varieties. One is the American Upland, the standard U.S. plant, which gives high yields and is disease resistant. The other is Sea Island, the Egyptian variety. It is a comparatively low-yield, disease-prone plant, but it has a fine, long-fibered boll that produces high-quality threads.

Countless attempts have been made to cross the two breeds, but the best that was ever achieved was a single-generation cross—one that separated out in the second generation. By irradiating the seeds and selectively pollenating resulting plants, Osborne has achieved at least one cross that has been stable for several generations, although it has too many undesirable characteristics to be of any value. In a few more years, he may well come up with the long-cherished Sea-Island Upland species.

Although the Lab in the past has tried to improve animal breeds, it has given up such work because the generation process takes too long for fruitful experimentation. Its work today is centered largely on determining the effects of radiation on animal ecology and on pinpointing the effects of radiation on metabolism.

To carry on these experiments, the Lab has a large, well-equipped veterinary facility, complete with modern stables, a fully equipped animal surgery staffed with some of the most highly qualified vets alive, and a deceptively sinister little radiation pad, where Gamma-ray sources are imbedded in concrete, and special holding stalls are designed so that animals can be irradiated over their entire bodies—or else shielded so that only a particular body area or organ is exposed.

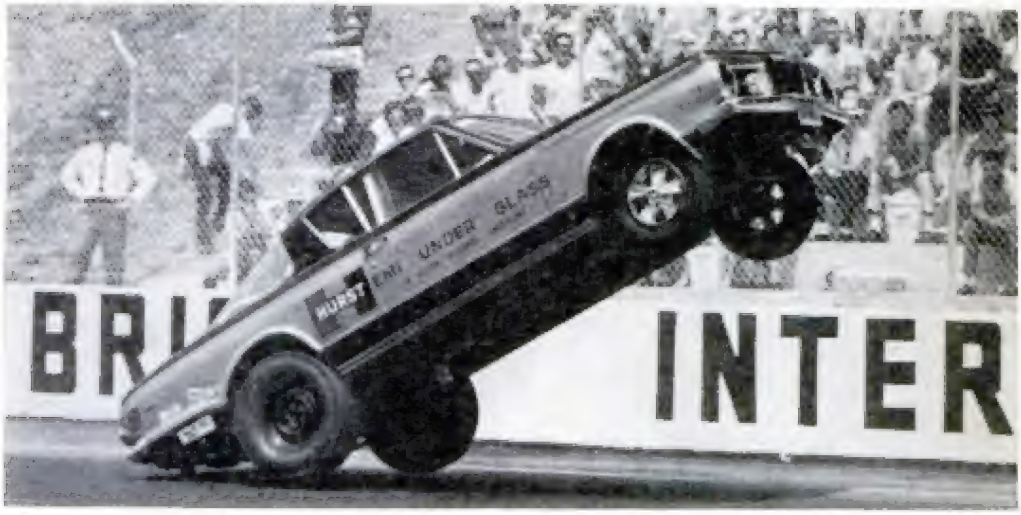
One of the most promising current experiments is being carried on now by Dr. Matthew Wykoff, who has discovered that low-level radiation affects the manner in which the brains of burros metabolize glucose, one of the basic nutrients. "I may be onto something fundamental in the chemistry of mental disorders," says Wykoff. "It's hard to tell just now."

Fathoming Nature's secrets, it seems, is as difficult as improving on Her. ★★★

Big Socket

Perhaps the largest "wall socket" in the world, this one from Germany needs two men to plug into it.

Plugging in taps a 35,000-volt supply designed to provide a special source of electrical power to industrial plants. The Siemens power unit is described as "portable" —though it'd appear you need a large truck or railroad train.



Flying "Fish" Skims Overland

All four wheels airborne, this Barracuda starts down a drag strip on its bumper casters. The "Hemi Under Glass," driven by Bill Shrewsberry of Los Angeles, does most of the quarter mile on its hind wheels. Engine is a rear-mounted hemi 426.

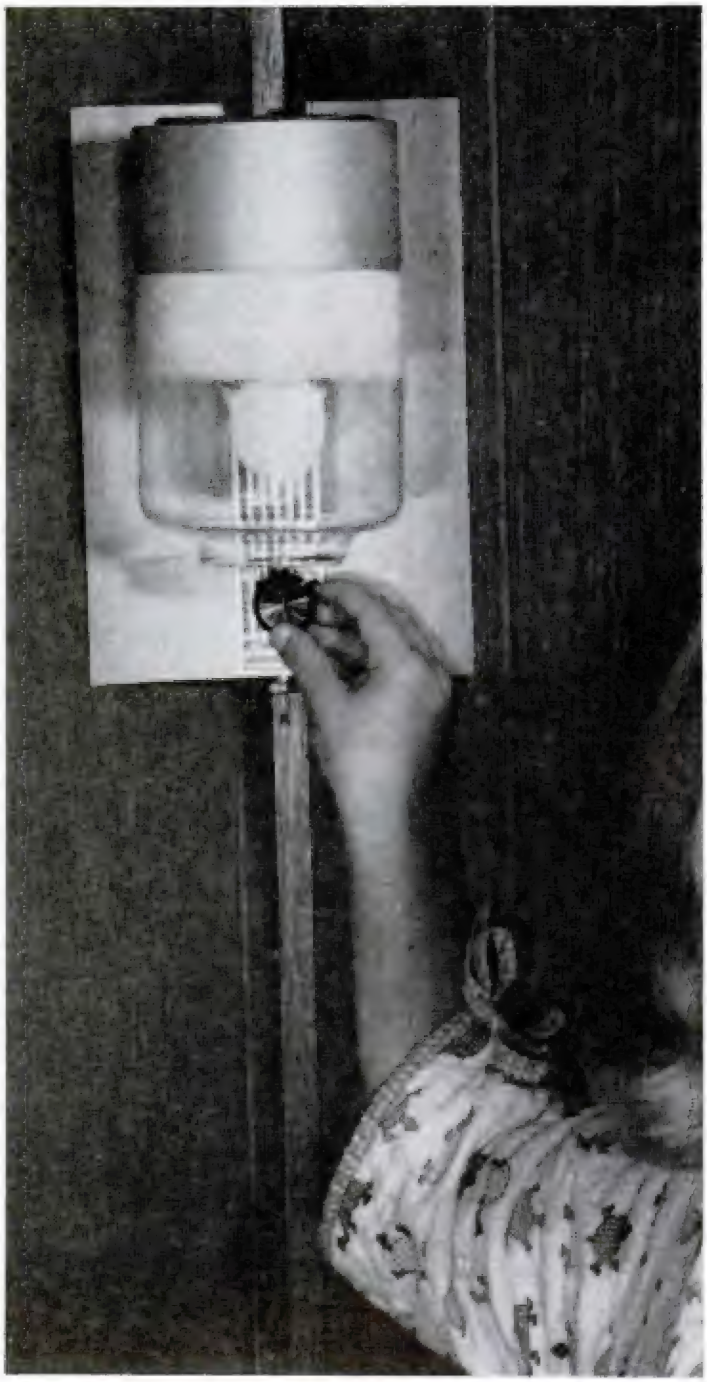
Black TV

Black glass mounted across the front of a new Westinghouse 19-inch portable TV eliminates that staring-eye look when the set's turned off.

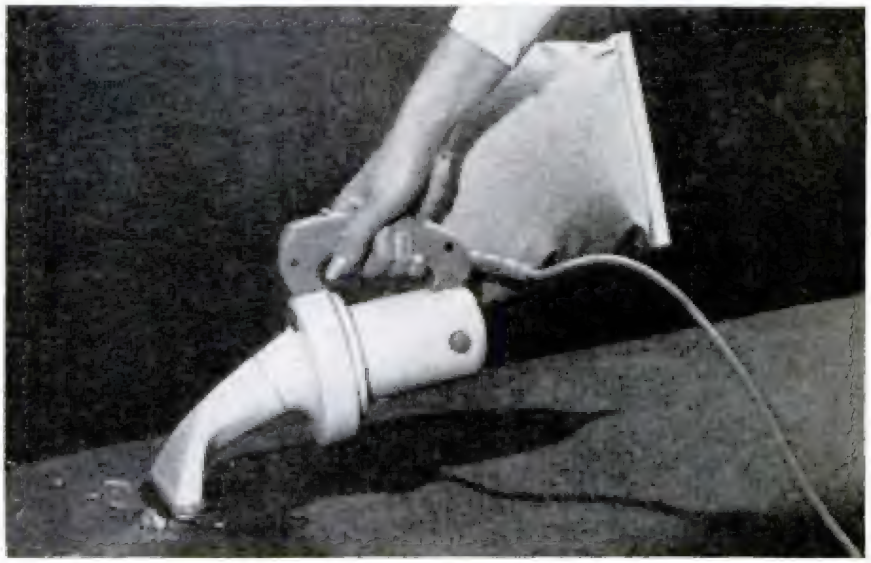
When it's operating, the glass filters light from the screen to give a picture that is softer, clearer and easier to watch. An instant-on circuit produces a picture as soon as the set is switched on.

***CARRYALL** of plastic holds several separators which can be arranged to fit large or small shop, household or garden items. Unit is 15 inches long, comes in colors, costs 99 cents from Snyder Co., Westmoreland and Stokley, Philadelphia, Pa.*

***MAIL TRAY** slides into and out of standard size R.F.D. mailbox, slides forward, tilts downward to bring mail within easy reach of a car window or children. In plastic, it's $1.49. Available from Epco, Inc., 2614 Nicollet Street, Minneapolis, Minn.*



***MANTLE LAMP** for natural or L/P gas mounts on flat walls or in corners, conserving space. Unit is well suited for standby or emergency lighting in electric or mobile homes. Price: $15.50. By Humphrey Prod. Div. of General Gas Light Co., Box 2008, Kalamazoo, Mich.*



***HAND VACUUM CLEANER** is designed for easy touch-up cleaning in home, car, boat or workshop. Unit weighs only 5.2 pounds, has 20-foot cord for wide-area coverage. Frame of unit is cast aluminum. The .14 hp motor gives one-third the suction power of standard vacuums. Price: $24.95. Available at all Singer Centers.*

***LOUVER SCREEN** installs in ordinary window frames, provides privacy. Screen cleans with hose, costs $2 per sq. ft. Louver Screen Co., 1214B W. Burbank, Burbank, Calif.*

***LIGHT SWITCH HANDLE** allows children to turn lights on or off without adult help. Ten-inch pull screws onto switch plate. $1 from Look Products, Box 271, Deerfield, Ill.*

PLYFOAM:

Thanks to this new miracle material, you can now produce fiberglass projects in your own workshop. No complicated forms required—Plyfoam is the form. You can bring it to forming temperature with a simple heat lamp and bend it into any shape—even compound curves. It sets in that shape as it cools. When coated with fiberglass it forms a tough, lightweight sandwich. Here's PM's exclusive report on what you can do with this remarkable shop material.

Incredible new workshop wonder

By Arthur Mikesell

A THOUSAND SHAPES to suit any project, plus featherlight construction with incredible strength—it's all possible with Plyfoam, a revolutionary new material that makes fiberglass construction practical in your home workshop.

A true thermoplast, Plyfoam is a rigid foam sheet that becomes pliable as felt when heated to about 200°. You can form it into compound curves, bend it with almost complete freedom of shape. Once it cools, however, it becomes rigid in the new shape and can be covered with fiberglass to produce an ultralight, strong sandwich construction.

Available in 46 x 56-in. sheets of ¼-in. and ½ in. thicknesses, Plyfoam is a special type of unicellular polyvinyl chloride plastic from Plyfoam, Inc., E. Bethpage Rd., Plainview, N. Y. You can cut it with a razor blade or pocketknife, sand and shape it more easily than balsa wood. It costs about 46 cents per sq. ft. for the ¼-in. thickness, 80 cents for ½-in. And considering what you can do with the material, they're not bad prices.

Everyone is familiar with the virtues of fiberglass-reinforced plastic: tough, waterproof, durable and almost completely maintenance-free. In normal fiberglass construction, however, you have to start with a complicated mold, and making this mold usually turns out to be at least as much work as building the project itself.

With Plyfoam, all you need is a simple form to hold the material to shape as it cools. Once shaped, the foam becomes a mold over which you apply the resin and fiberglass to produce a strong sandwich construction.

In addition to eliminating the need for a mold, Plyfoam makes a vital structural contribution to the finished project.

A single layer of fiberglass-reinforced plastic is flexible. To prevent unwanted flexing or "oil canning," the standard practice is to build up layers of glass until the required stiffness has been achieved. This is not only a lot of extra work, but it also makes the project much heavier and more expensive.

When used as the filling for a fiberglass sandwich, Plyfoam works like the struts of a steel bridge and produces an enormous improvement in strength-to-weight ratio. A sandwich panel of ½-in. Plyfoam between ⅛-in. layers of fiberglass increases the stiffness of the fiberglass by about 20 times. Such a panel will be stronger than high-grade plywood of the same thickness, yet weigh only about half as much.

Building a project with Plyfoam is simplicity itself. Normally, it

PLYFOAM

involves three steps: making a simple dimension control frame or shaping form; assembling the project in Plyfoam; covering the structure with fiberglass bedded in resin.

Forms and frames. Many simple projects can be built without any frame or form, since the Plyfoam sheets are quite rigid. For larger projects involving "cold forming" (bending the unheated Plyfoam to form simple curves), a simple wood frame is required. If no bending is necessary, this frame need only supply support points at 2 or 3-ft. intervals. If the Plyfoam must be curved, the support points will usually be spaced closer together.

A simple way to determine the proper spacing in such cases is to draw the curve full-size on a piece of lumber or plywood, then bend the Plyfoam sheet along this curve and tap small nails into the board to hold the sheet in place. This will quickly fix the minimum number of constraining points necessary and the proper spacing between them.

Any old pieces of lumber will do for the frame, so long as they provide the proper support.

If the project involves compound curves, the Plyfoam will probably have to be heated, and this means that you must provide additional support to define the curve. Lath or 1-in. strips of ¼-in. plywood, spaced about 2 in. apart and nailed over the frame where necessary, will prove sufficient.

The heated sheet will resemble a piece of heavy felt in consistency—carpet padding, for instance—and must be held firmly in position as it cools. Keep this in mind when determining the degree of support needed. Remember, however, that the frame can be very rough carpentry. The important thing is to provide the dimensions of the shape you wish to achieve, plus minimal temporary support for the foam sheet.

Working with Plyfoam. Almost any

SIMPLE FORM for bending foam into compound curves is slat construction with support at 2-in. intervals

HEAT FOAM one area at a time, working it down to conform to the curve, and anchor edges while it cools

FIBERGLASS CLOTH, precut to size, should be pressed into resin. If needed, brush more resin on dry spots

USE SQUEEGEE to press cloth into resin for thorough saturation, then remove any excess resin with it

kind of knife may be used to cut the Plyfoam to the shape desired, though the ideal choice would probably be a shop knife with changeable blade. Just mark the outline on the foam sheet and run the knife along the line. You don't have to cut completely through the foam, since it will break cleanly in any direction once cut about halfway through.

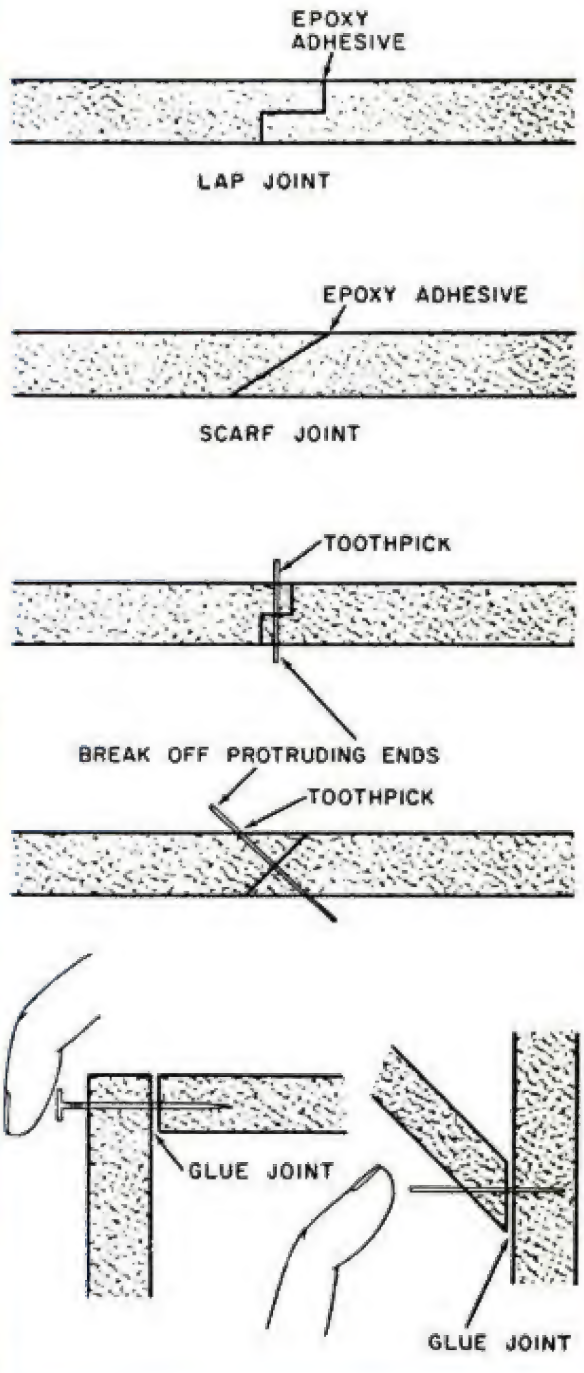
Shaping is best handled with a Stanley "Surform" file, though any coarse file, rasp or even sandpaper will work. A portable saber saw can also be used. It's especially handy for cutting duplicate parts by making one pass through several stacked sheets.

Plyfoam joinery is such a simple operation that you find it difficult to believe until you've done it. Basically, each joint is held with a two-part epoxy glue. Ordinary toothpicks or annular-ring nails are used to hold the joint temporarily while the adhesive sets. You simply push these in with your finger. Once the glue sets, any protruding toothpick ends can be broken off flush with the surface. Nails

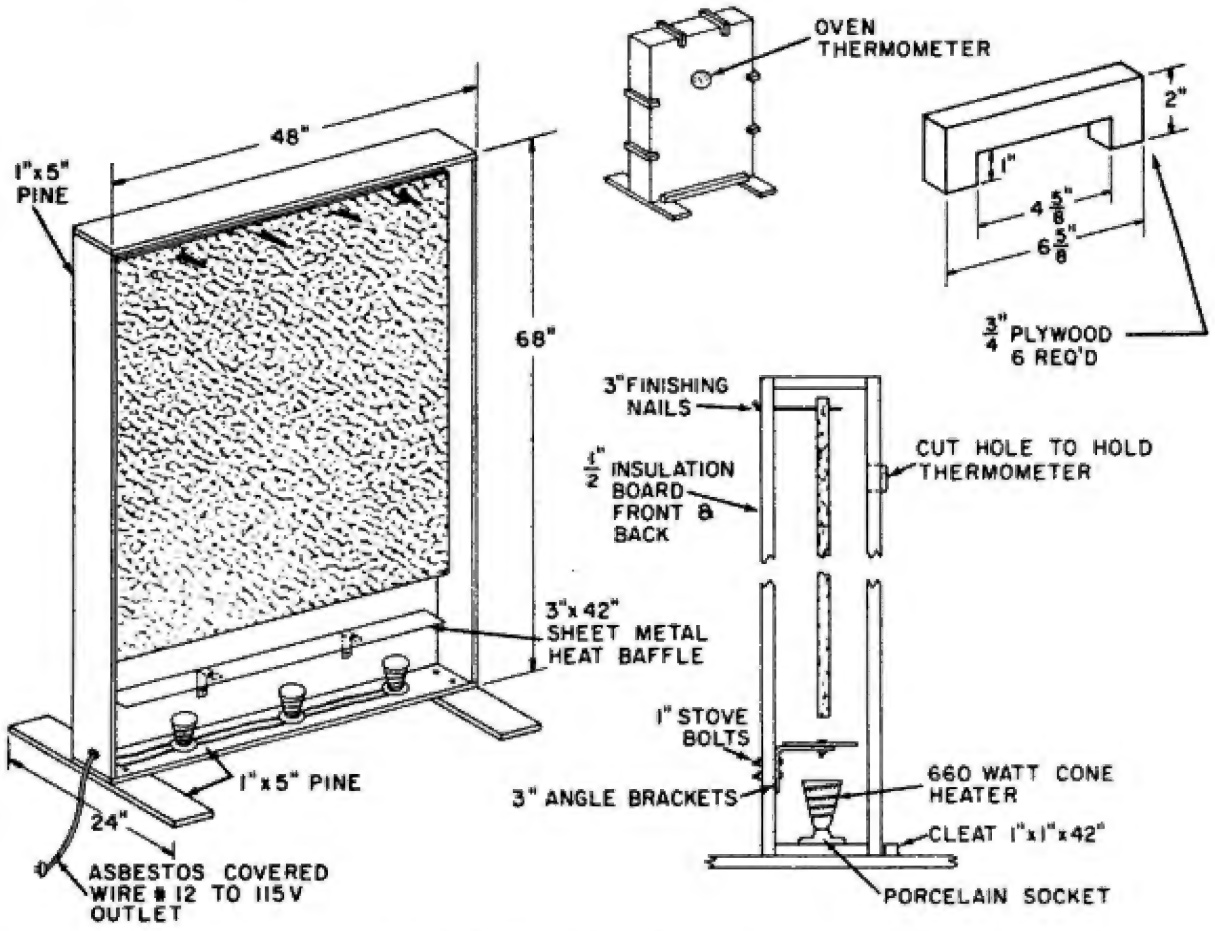
SPREAD RESIN evenly over the curved surface with a wide paintbrush before you add the fiberglass

COMPLETED JOB should show texture of fiberglass cloth evenly. Excess cloth can be trimmed off later

Plyfoam Joints



Sheet Oven



should be countersunk and left in the work. The joint thus produced is stronger than the foam itself, and a fiberglass sandwich incorporating such joints is as strong as if there were a continuous core.

A simple butt joint is usually sufficient for edge-joining two sheets, though somewhat more elaborate joints are sometimes desirable when making up a large sheet from several small pieces.

Right-angle joints are made in the same way as flat butt joints, applying the adhesive first and pinning the two pieces together by pushing nails or toothpicks through the joint.

Another way of holding a butt joint while the adhesive dries is useful when fitting successive sheets to a frame. It involves looping a wire across the joint, pulling it flush to the foam surface and twisting the two ends together around a frame member under the joint. When the adhesive has set, the wire can be cut.

Where more strength is required, add a fillet of foam. This will impart extra rigidity to a right-angle joint. It's also a good idea when mounting load-bearing panels, such as shelves or boat seats.

Heat-forming Plyfoam can be accomplished in a number of ways. Sometimes it's possible to form the desired curve by using a heat lamp, shaping one small area at a time. Hold the heat lamp a couple of inches away from the foam. Depending on the shape you want, this technique may even be used with large panels.

If the project is a small one, you can heat the sheet in a kitchen oven. And don't forget that almost anything can serve as a form—a box for a good 90° bend, for instance, or a can for a radius.

A "planking" technique is sometimes the easiest way to produce a large compound curve. By fitting strips together, one at a time, beveling the butting edges as required, you can produce extremely complex shapes using a heat lamp. Use

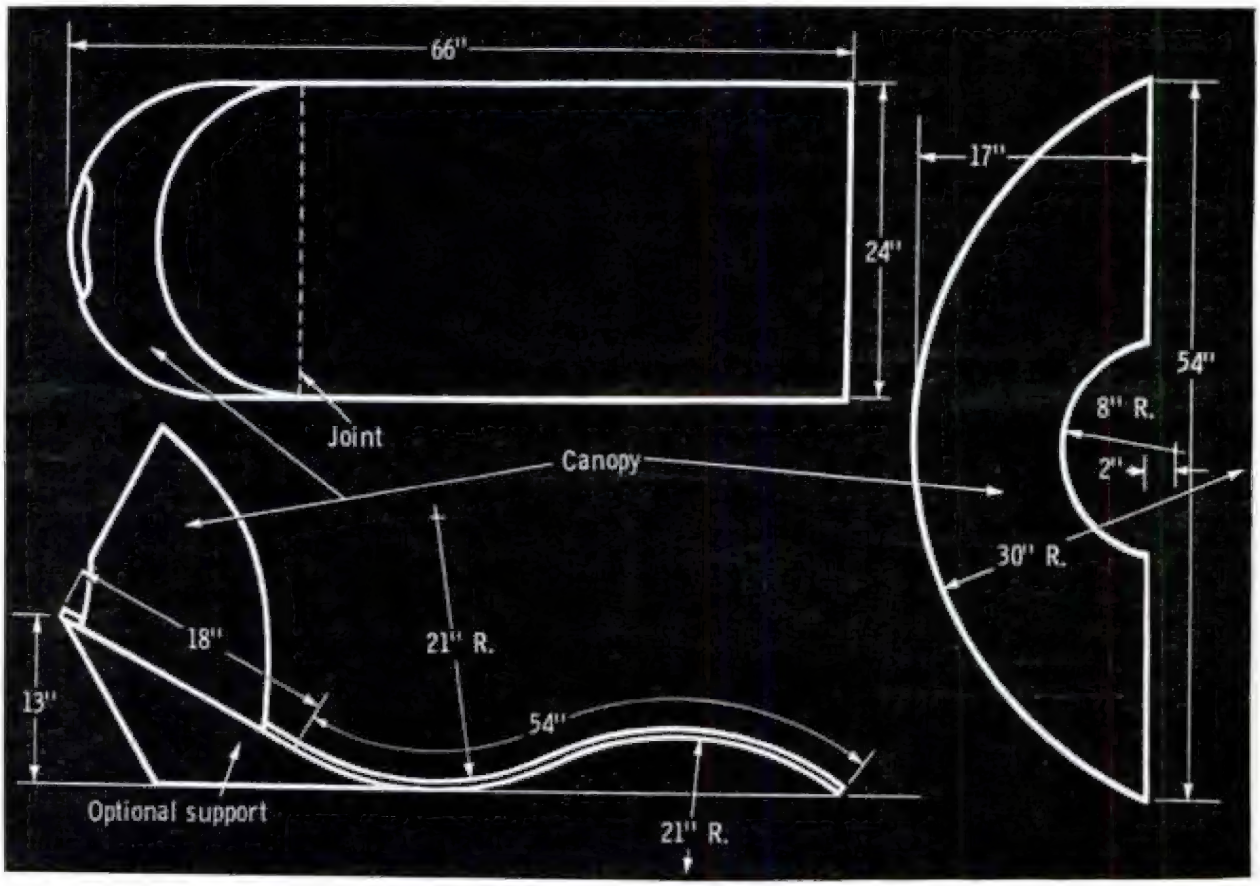
(Please turn to page 244)

PLYFOAM Project Ideas

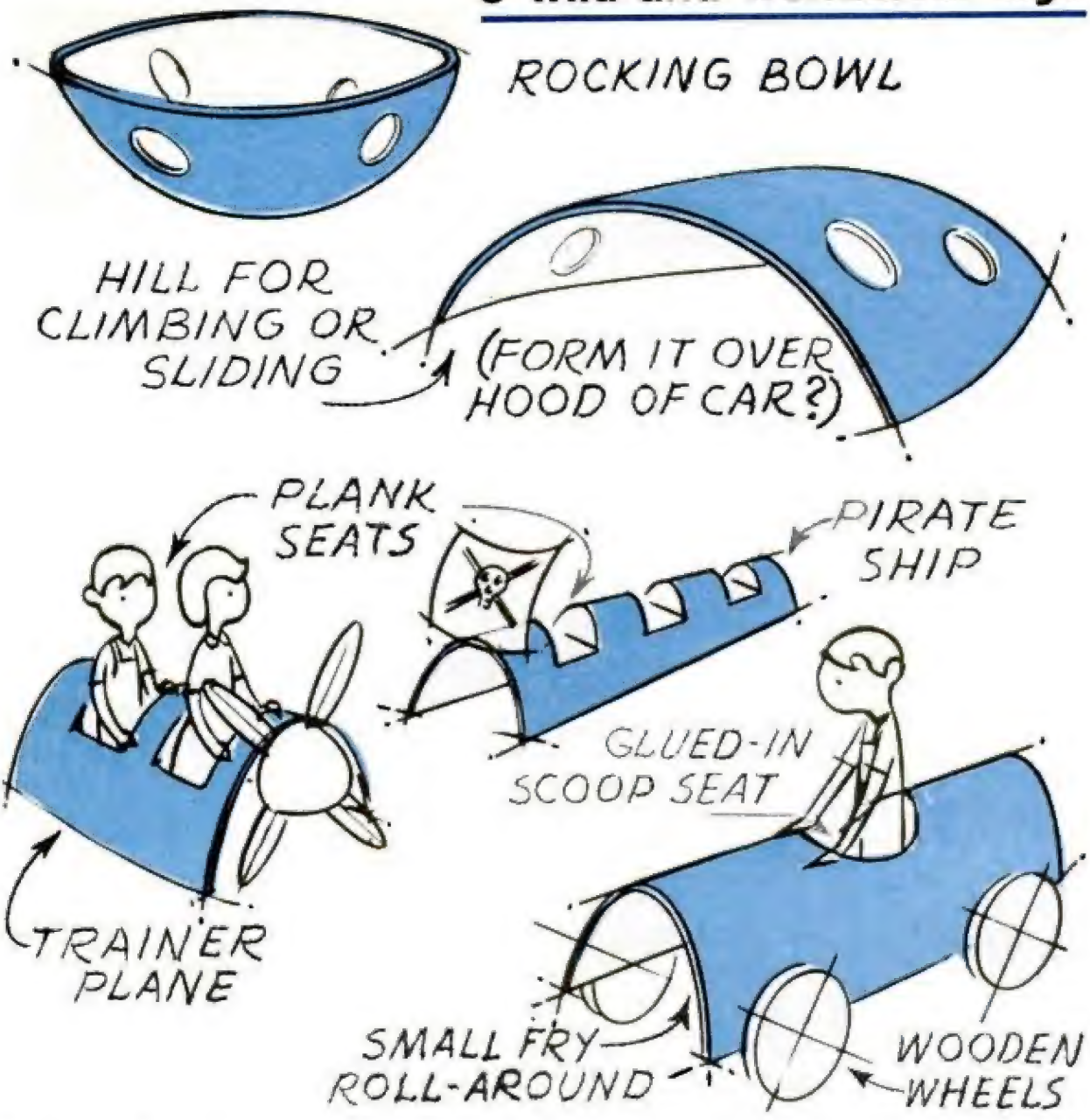
Now you know how Plyfoam works – how its moldability banishes many of the restrictions that may have cramped your workshop style. And yet *because* it's so new and so unlike material you're familiar with, PM asked noted designer Franklyn Jacoby to sketch up a few projects that would test Plyfoam's design potential.

One of his projects—the hooded chaise you see here – was actually dimensioned and built as a practical demonstration. Other of Mr. Jacoby's ideas appear on the two following pages, reproduced directly from his sketch pad to springboard your own imagination toward the creation of projects that weren't possible before.

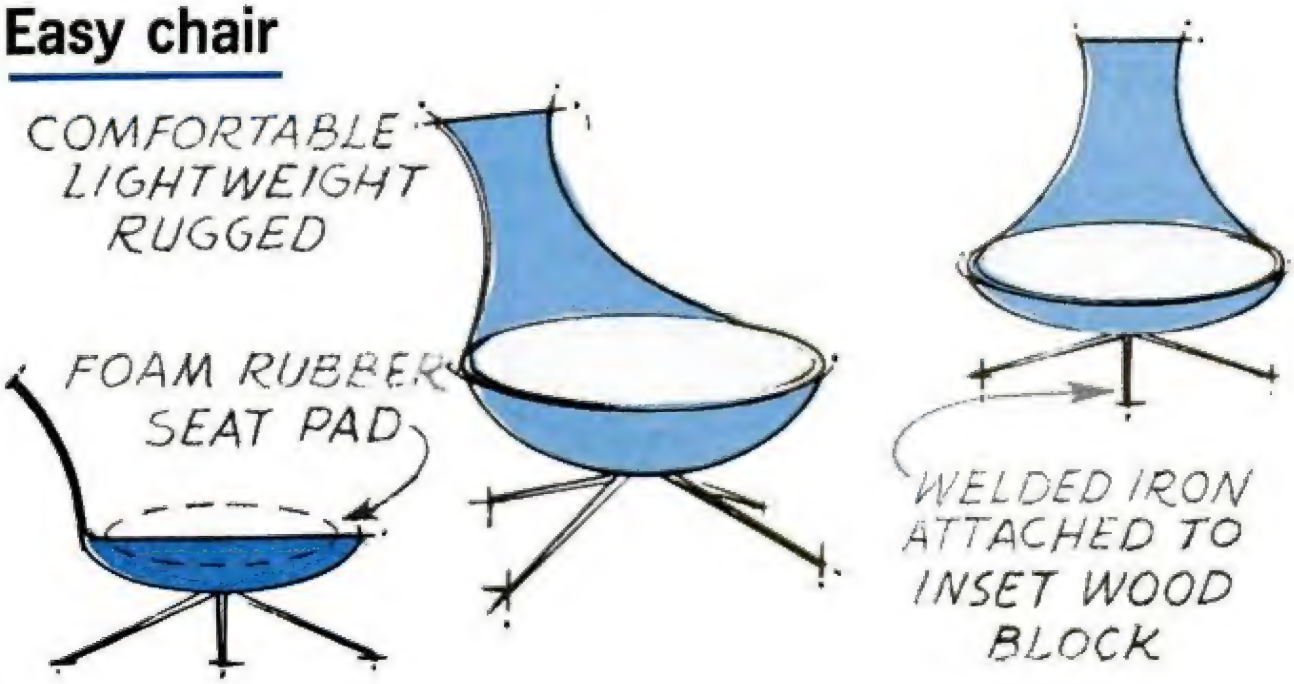
Hooded Chaise



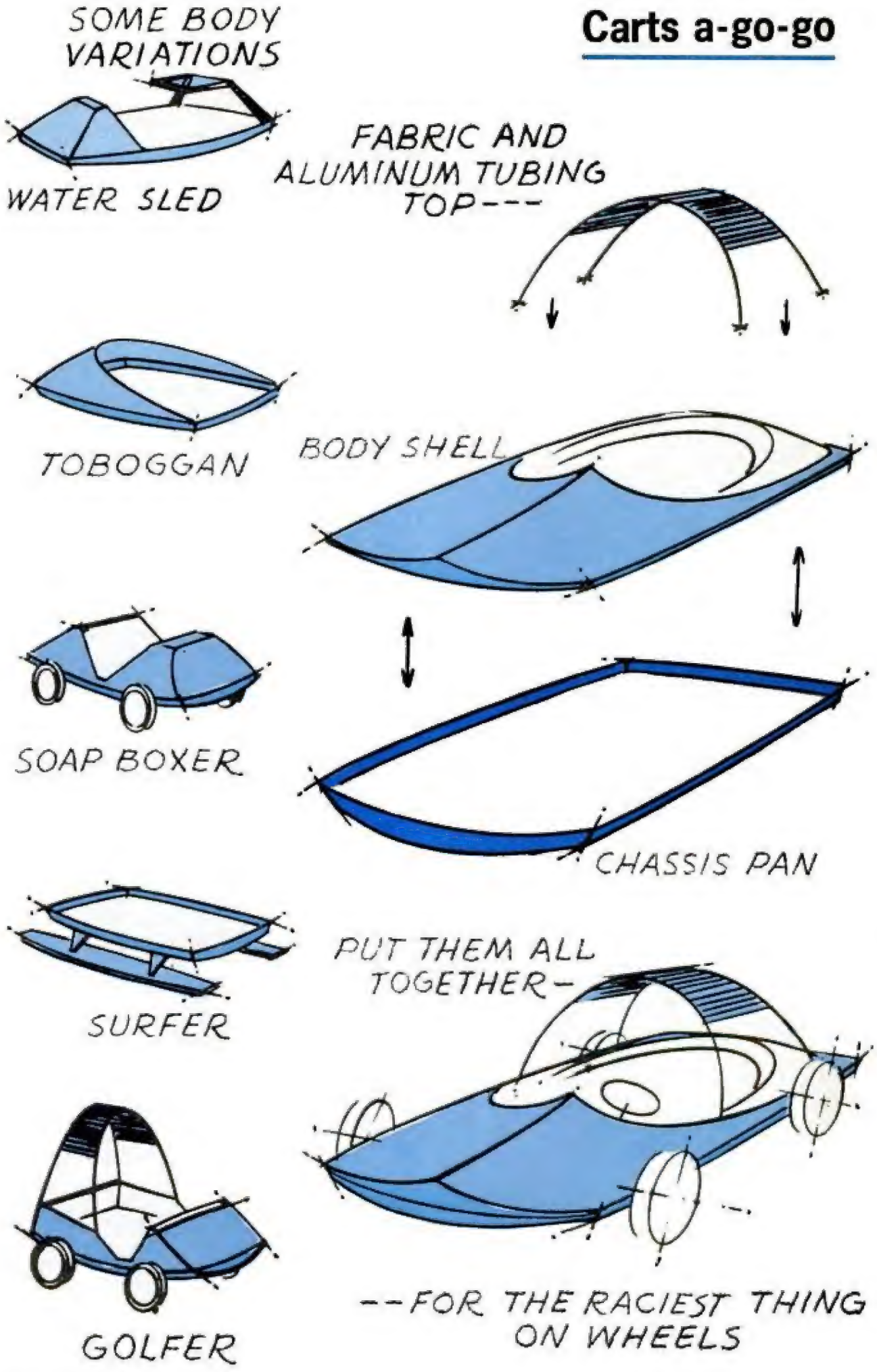
5 wild and wonderful toys



Easy chair



Carts a-go-go

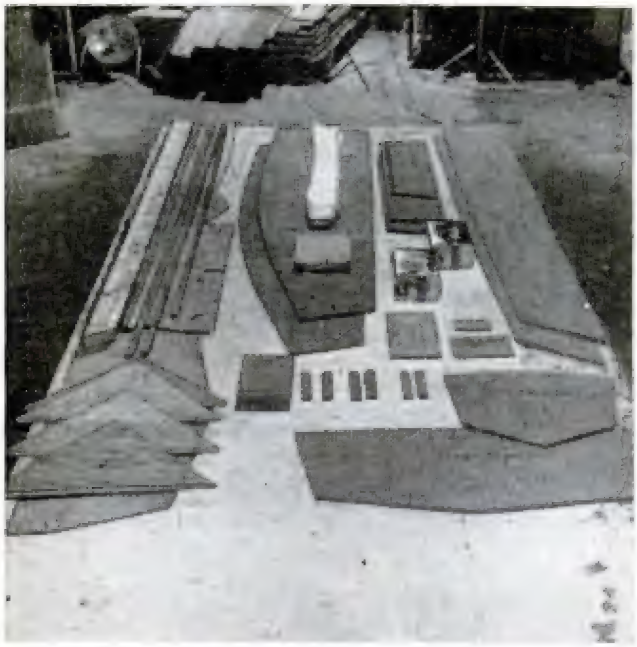

SOME BODY VARIATIONS
WATER SLED
FABRIC AND ALUMINUM TUBING TOP---
TOBOGGAN
BODY SHELL
SOAP BOXER
CHASSIS PAN
SURFER
PUT THEM ALL TOGETHER-
GOLFER
--FOR THE RACIEST THING ON WHEELS

PLYFOAM Boat Building

Plyfoam is an ideal material for building boats, not only because of the general construction advantages mentioned earlier, but because it provides built-in flotation, like wood.

As a matter of fact, the material was originally developed for use in boat construction. John T. Potter, president of Potter Instrument Co., Inc., and an enthusiastic yachtsman, heard about PVC foam in Europe. Upon further checking, he learned that B.F. Goodrich had a strong background in the field of foam plastics.

Potter went to Goodrich with his requirements—a PVC foam with thermoplastic characteristics, density and strength suitable for marine construction—and the result a jointly operated development program is Plyfoam. Plyfoam, Inc., is the company founded by Potter to market the



SEA SHELL PRAM KIT includes all the necessary parts for the boat and frame, precut to the proper size

BUILDING FRAME is assembled on a single 2 x 4 and rests on two sawhorses. The floor should be level

WORK QUICKLY when applying resin and cloth. Use squeegee to remove wrinkles, work out trapped air

AFTER RESIN CURES, lift hull off frame and place it in a simple cradle while you glass the interior

new material, manufactured by B.F. Goodrich exclusively for this company.

Touche III, the first boat built from Plyfoam, is a 37-ft. trimaran with a beam of 20 ft. Designed for Potter by Britton Chance Jr., it weighs only 5000 lbs. and carries a 1200-lb. keel. Under ideal conditions, it can beat any America's Cup 12-meter. You'll find a picture on page 248.

While many boat companies expressed immediate interest in Plyfoam for production boats and are now engaged in design research work with it, the first Plyfoam boats to be made available to the public are two kits from McNair Boat Works, Inc., 27 Munson St., Port Washington, N.Y.

The largest is a 15-ft. 6-in. runabout OBC rated for 95 hp and weighing about 400 lbs. It's shown on page 248.

The other is an 8-ft. Sea Shell pram, construction of which is illustrated below. A 40-lb. lightweight, it's the kind of small utility craft that you can toss on top of your car or into the back of your station wagon. The $116.50 kit includes all the necessary Plyfoam parts, precut to size, plus fiberglass cloth, epoxy resin and fittings. In addition, it contains all materials required for the simple building frame.

(Please turn to page 249)

POLYETHYLENE SHEETING stapled on frame acts as separation membrane to simplify removing hull later

AFTER ASSEMBLING hull with push pins and glue, the edges are rounded so fiberglass will adhere well

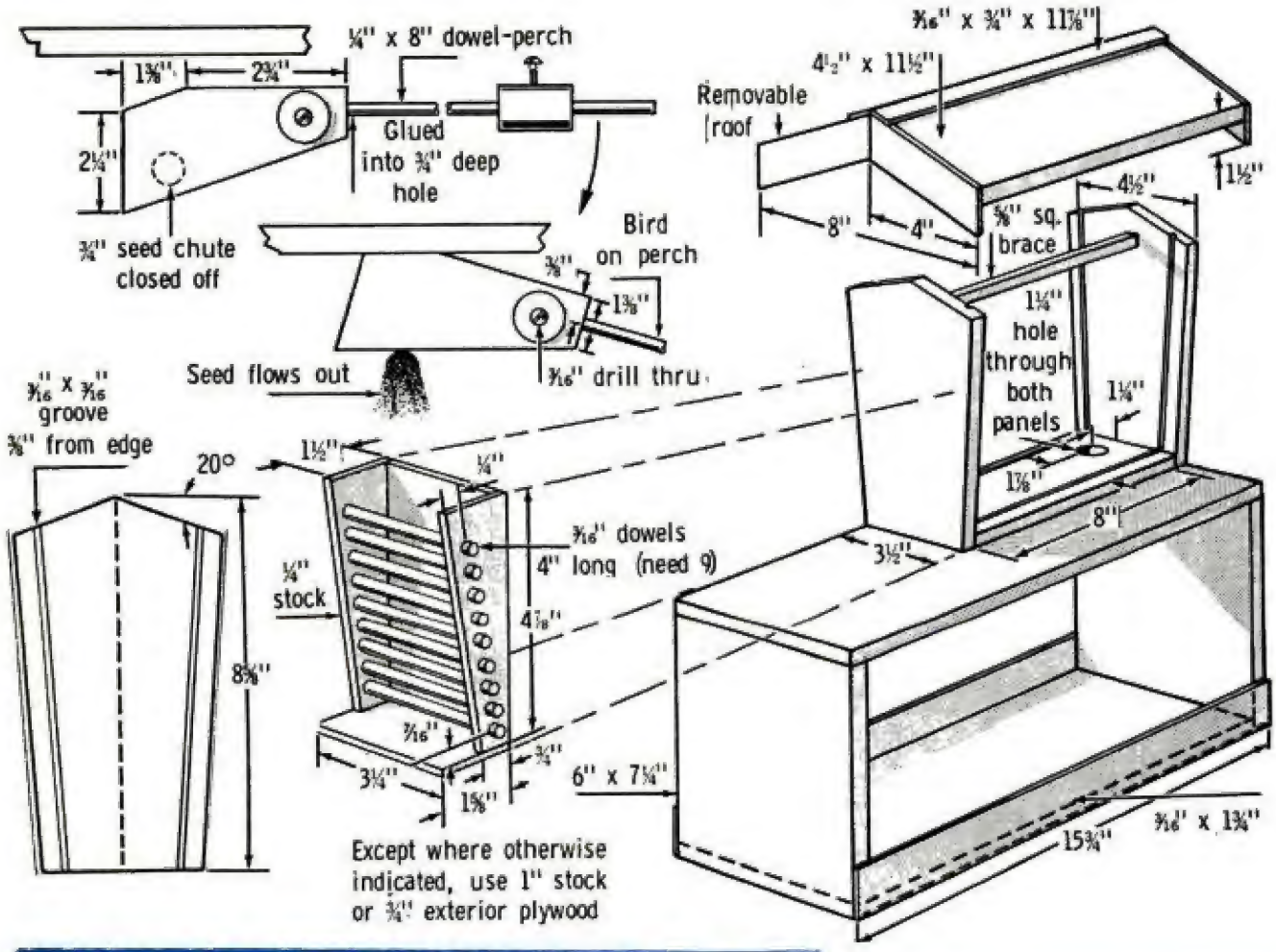
SEAT SUPPORTS and transom inset should all be added before you begin fiberglassing interior of hull

COMPLETED PRAM has all the virtues of fiberglass construction, yet weighs less than stock glass pram

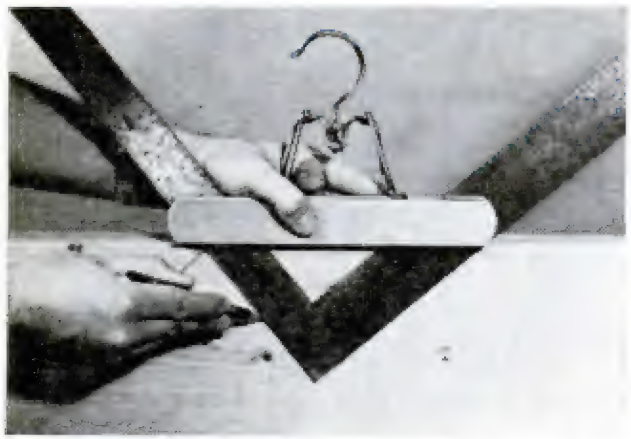
BIRD AUTOMAT

By P. T. Hennig

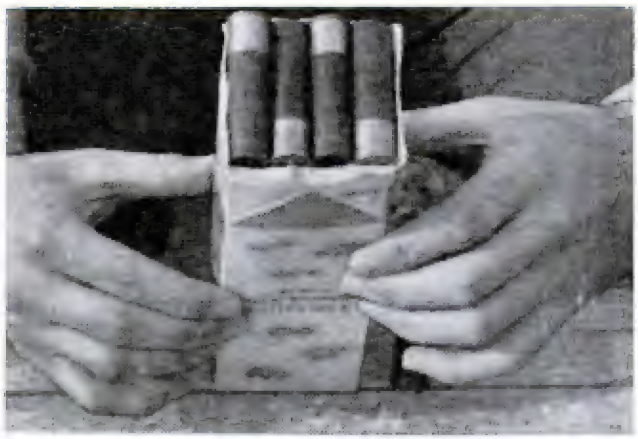
YOUR FEATHERED FRIENDS need no nickels to serve themselves at this automat. They only have to discover that when they light on the perch, seeds are automatically dipsensed down a chute and onto the feeding table. Since the seeds are stored "upstairs" in a hopper with a removable roof, they keep dry, and won't blow all over the yard. In watching the birds, you'll be surprised how quickly they catch on in getting themselves extra helpings. The suet provides dessert.



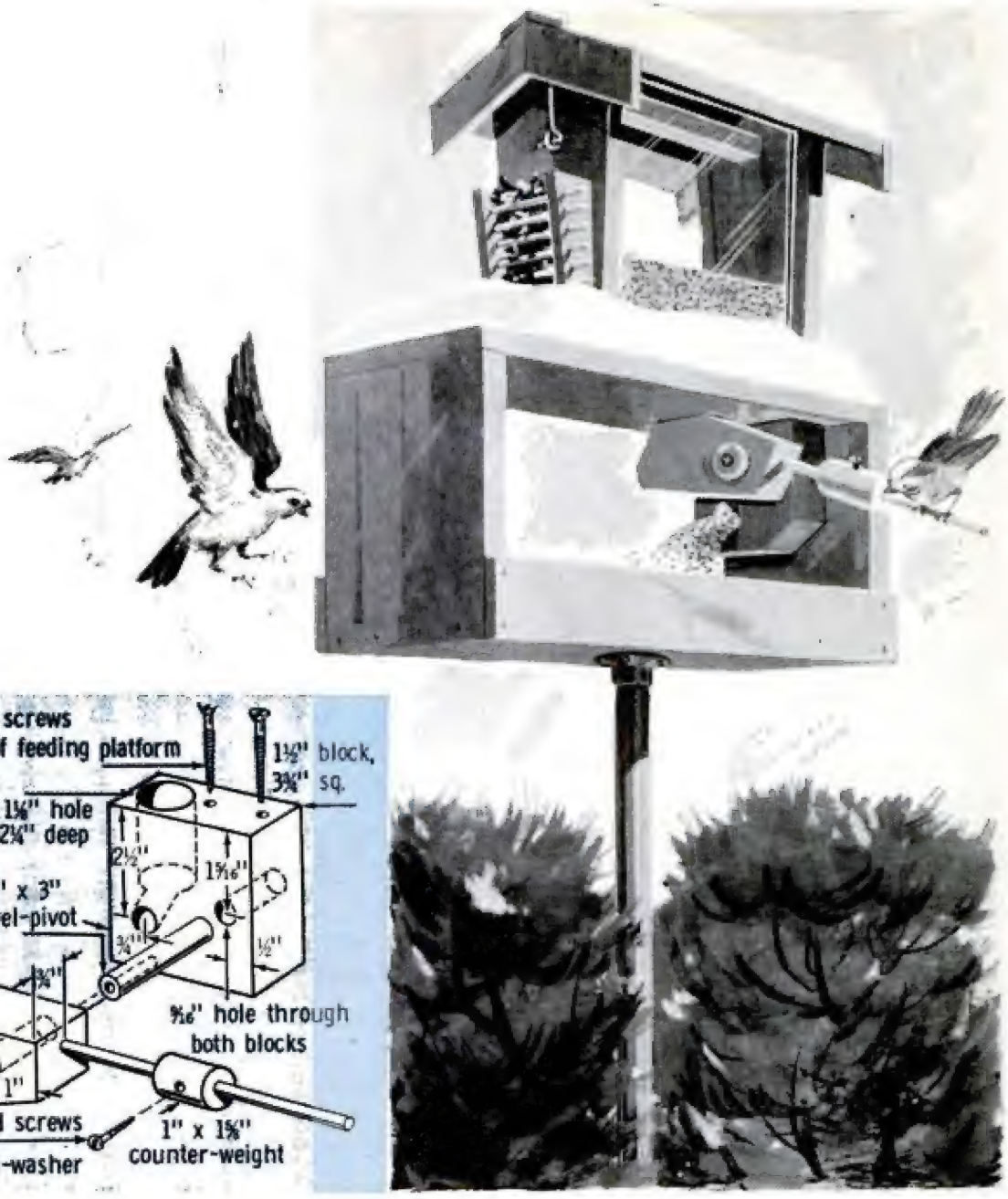
TAKE A HINT FROM READERS

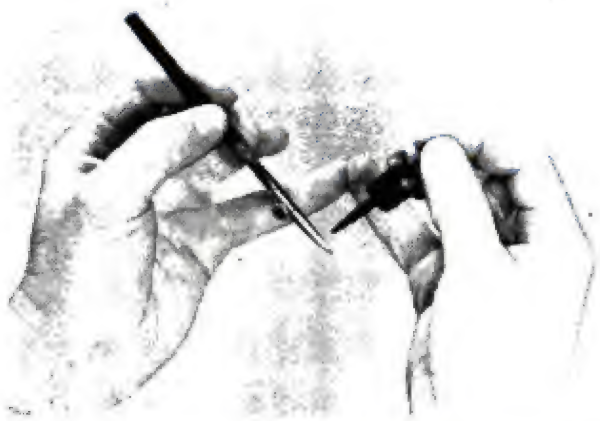


CLAMP A PANTS HANGER across the corner of a square as shown and you can mark off a series of identical angles, as in laying out stair stringers or rafters. Felt pads inside jaws keep the hanger positioned as it rides along edge of stock.—*Ken Patterson*



EMPTY SHOTGUN SHELLS can be neatly stored in cardboard milk cartons until you accumulate a batch for reloading. Each carton holds a generous supply and a number of filled cartons can be stored compactly on any convenient closet shelf.—*John Krill*





WHEN STEADY HANDS are needed for a delicate job (such as inking a drawing pen) press the tips of your little fingers together as shown and pivot your hands from the wrists for whatever movement is required by each of the other fingers.—*Bob Gilmore*

DOLL BABY BOTTLES make fine dispensers for small quantities of glue, letting you buy an economical supply to divide up for many jobs. The hole in the nipple lays a delicate pencil-line of glue when you squeeze one of the plastic bottles.—*Frank Bartonek*

Is Your Run-off System Doing Its Job?

Every part has its function: Flashing should see to it that rain *does* run off, not through cracks at chimneys and roof joints. Gutters and downspouts must then carry the water quickly away from the house. Here's how to check your system—and how to improve it with new materials and techniques

YOUR HOME is under constant attack. Nature is fairly relentless in her attempts to wash it away with rain or bury it under snow. Fingers of moisture are forever probing its weak spots in hopes of emplanting mildew and rot. Your roof must ward off thousands of gallons of water each year.

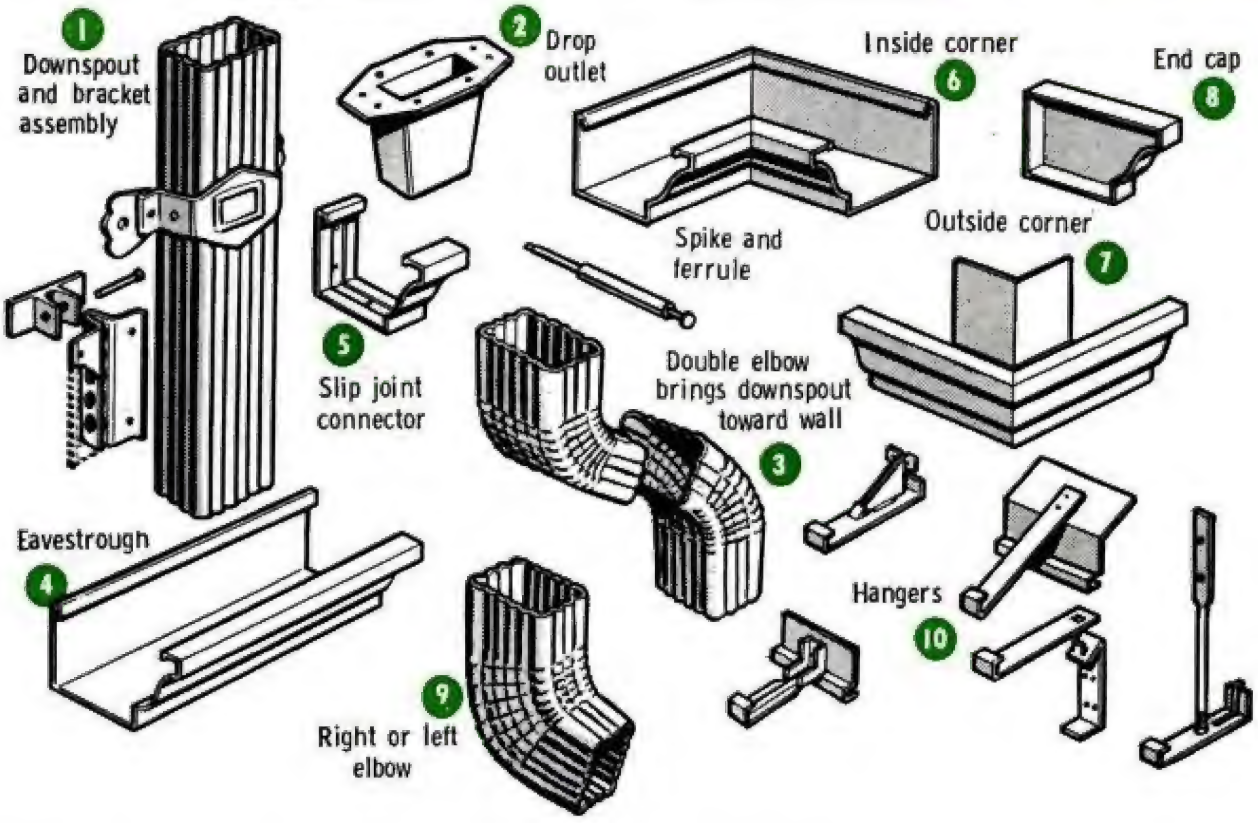
And now's the time—between the bombardments of summer thundershowers and of winter sleet—for you to take stock of your home's first line of defense—the flashing and guttering that channels all this water safely away from the house . . . or *should*. The whole "chain" is only as good as its weakest link. If your flashing has deteriorated or is no longer tightly sealed at the edges, you're in for trouble *upstairs*, at the first sign of a thaw. If you've let sags or leaks develop in your gutters so that water stands in them and trickles down your siding, you may have a paint-peeling problem next spring. Or if you merely let autumn leaves fill your gutters and clog your downspouts so that the water backs up and spills over to soak into the earth around the foundation, you're asking for a wet basement.

Also, by running a check at least once each fall, you can catch any problems in the system itself that might result in a replacement bill of several hundred dollars if they went undetected.

It's tough to quote exact figures as to what a replacement system can cost. There's a wide range in gutter quality, and prices vary from area to area. Our chart on page 161 is only intended to offer a general comparison of costs; we've attempted to reflect a national average in

CHECK SPLASHGUARD at each downspout to be certain water is draining well away from foundation. Dispersal devices can be substituted for splashguards

DRILL-POWERED WIRE BRUSH is ideal for polishing rusted gutters down to sound metal, for repainting or patching. Use grounded extension cord outdoors



PATCH WON'T STICK to surface coated with loose particles. Most efficient means of assuring clean surface is to drag a small vacuum cleaner up there

APPLY EVEN, HEAVY COAT of roof cement over damaged area, then press piece of heavy aluminum foil into place, follow with another good coating of cement

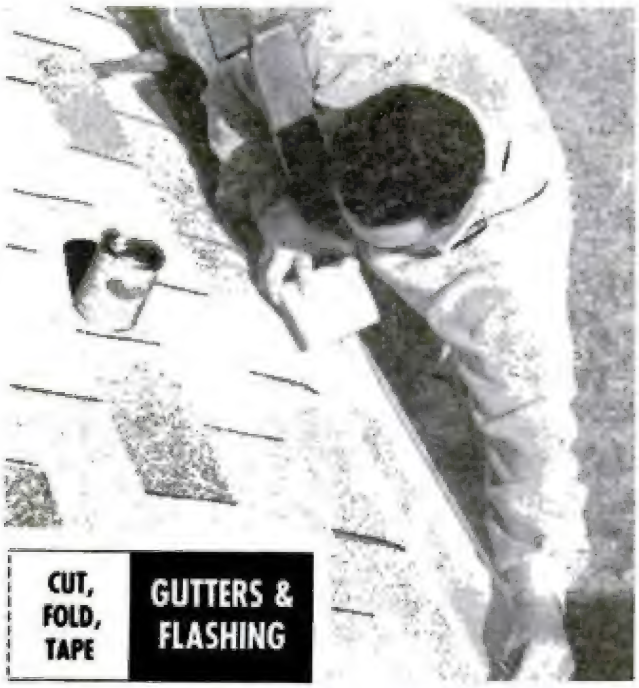
CHECK DRAINAGE of eaves by pouring bucket of water in at midpoint, watching to see how quickly it flows toward downspout. It shouldn't "puddle"

GUTTER SCREEN is easiest of all leaf guards to install; it's aluminum, so cuts with scissors. Tuck one side under shingles, insert other into gutter lip

our price figures. But it's important to bear in mind, as you check your present gutters, what types are available if replacement proves necessary.

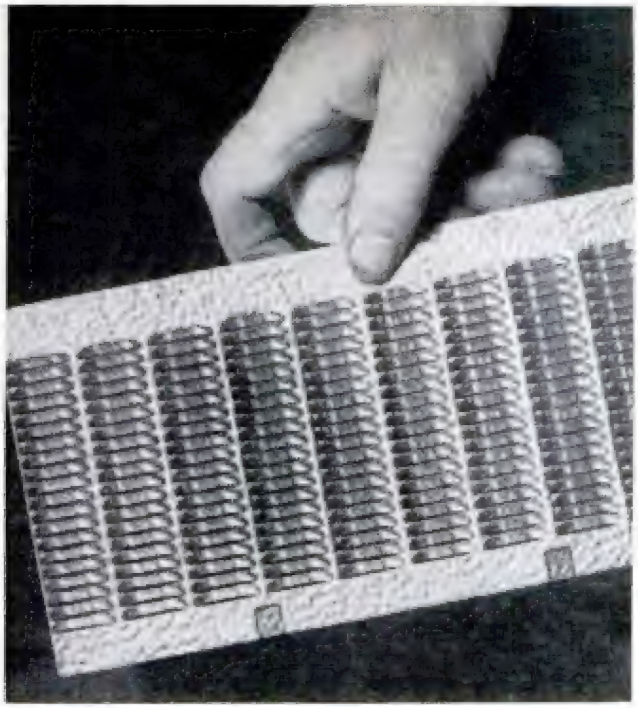
It's generally agreed that the biggest maintenance headache is provided by old-style wood gutters. Unless they're cared for regularly—at least once a year—they can rot. And once rot starts, replacement's not too far behind, because piecing in a new *section* is seldom practical.

If your home is equipped with wood gutters that are fairly new, you might consider a bit of *preventive* maintenance to make them last: If the inside surface of the guttering has never been treated, you can line it with fiberglass, as shown in the photo below, left. The cloth is available in rolls of various widths and the resin you'll need to cement it in place can be



FIBERGLASS CLOTH laid in a bed of resin and with a second coat brushed over it, creates a permanent patch for a large deteriorated section of gutter

MAINTENANCE-FREE system has all components made of rigid white vinyl plastic—assembles much as metal systems do, except joints (as above) are cemented



ANOTHER TYPE OF GUARD is rigid aluminum sheet stamped into rows of tiny louvers. Tabs on outer edge clip onto gutter lip to keep guard from lifting

CAGE-TYPE STRAINER may be required in downspout opening, especially with uncovered gutters, to keep leaves and other debris from clogging the downspout

purchased at any boating suppliers. The job requires careful preparation, since the cloth won't bond to anything but a clean, raw-wood surface. Scrape the trough down with a wire brush and make certain all loose particles are then swept away or vacuumed up. Apply the first resin coating, line the trough with cloth and brush on a final resin coat.

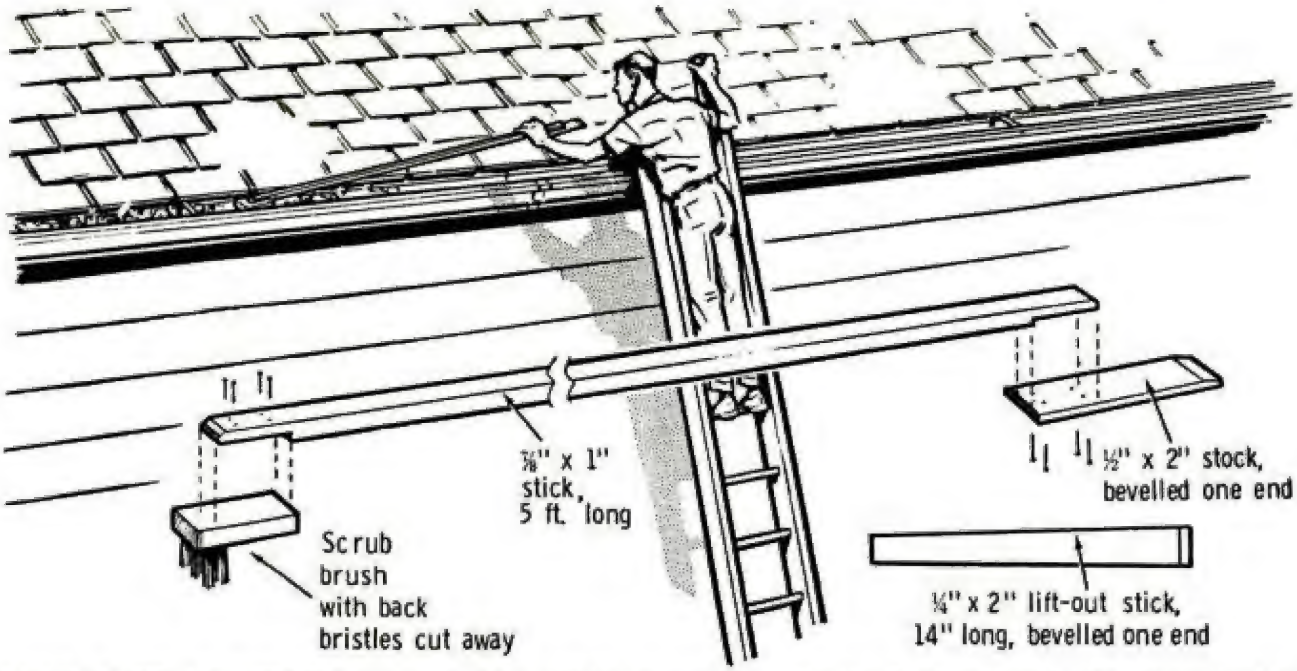
A less expensive treatment for raw wood gutters—but one that must be repeated annually—is two or three coats of linseed oil. Many gutter specialists prefer this to the special gutter *paints* which, they claim, tend to impede water flow. However, if your gutters have been previously painted inside, repainting is the only maintenance possible.

Metal gutter systems are generally more practical, but there's a big range in types and costs. First of all, there are two standard shapes—half-round and box. The latter is also called "K" or "OG" and is available in two sizes, based on the top width of the trough. The choice of size depends on the type of rainfall common to your area. If your home has a fairly large roof area and is subjected to frequent heavy downpours, you'll probably need 5-in. guttering to prevent overflow. If light rain is more characteristic of your weather, the 4-in. size will suffice.

Until recently, the standard metal gutter was galvanized steel—but this requires

COST COMPARISONS BY COMPONENT

Type of System	4"				5"			
	Down Spout 10 Ft.	Eaves-trough 10 Ft.	Corner	Elbow	Down Spout 10 Ft.	Eaves-trough 10 Ft.	Corner	Elbow
Half-round Galvanized	–	–	–	–	$1.35	1.35	70¢	40¢
Box Galvanized	$1.55	1.45	79¢	40¢	1.55	1.75	89¢	40¢
Box Aluminum	–	–	–	–	1.69	2.45	95¢	39¢
Box Enameled Steel	2.59	2.55	98¢	49¢	2.59	2.75	1.10	49¢
Box Enameled Aluminum	–	–	–	–	2.85	3.50	1.25	59¢
Box Vinyl Plastic	4.80	5.50	1.32	88¢	4.80	7.20	1.65	88¢



CLEAN 14 FEET OF GUTTER from one ladder position by making this simple double-end stick. It works just as well with bridge-type hangers—you push the debris at the limit of your reach under the hanger, to be pulled toward ladder in its next position. Use short stick for lift-out at ladder where long one's awkward

consistent maintenance to prevent rust. For this reason, aluminum guttering has been steadily gaining in popularity. Aside from higher cost, it has only one disadvantage: though not subject to rust, aluminum won't hold up well in areas close to salt water or heavy industry. So if you live where there are ocean breezes or chemical smog, you'd have to give exposed aluminum at least as much care as you'd give galvanized steel.

And you can't paint new aluminum gutters the minute you put them up, since the metal must form an oxidation coat before paint will adhere. Since this takes about six months, corrosion from air that's laden with salt or chemical waste could be well advanced before you dared apply paint. And even then, it's unlikely that, however carefully you brushed, you'd get a perfect sealing coat.

For just such problem areas, a pre-finished aluminum gutter was developed. It has a baked-on plastic coat that makes the metal impervious to rust *or* corrosion. The disadvantage here is considerable advance in price.

Gutters are also made of copper, but this is usually a custom, luxury installation, out of the do-it-yourself realm.

The newest gutter-and-downspout system to reach the market involves no metal at all except for hangers and brackets. All water-carrying components are molded from rigid white vinyl plastic and are solvent-cemented together at the time they're installed. The system will last the life of the house with *no* maintenance beyond

HOW TO PATCH A DOWNSPOUT LEAK

Since there will be little pressure against the patch, you can repair a downspout leak with weatherproof self-adhesive aluminum foil tape, developed by Johns-Manville. First (far left) clean the area with fine steel wool, then measure off the length of tape needed and cut it from the roll. Finally press firmly over area with blunt tool

the usual clean-out. The tough material won't chip, dent, wear away, warp or sag: nor will it support fire or conduct electricity. It also reduces the noise level of water flow. Originally introduced as a 4-in. system (in the standard box shape), vinyl guttering has just been made available in the 5-in. size.

There are only two possible disadvantages to this material. Vinyl is substantially more expensive than other gutter or downspout systems, and it is available only in white. You *could* of course paint it to match a colored siding or trim, but you'd then be introducing a maintenance problem. Of course, repainting in this case would be strictly for looks, since the paint wouldn't be offering protection.

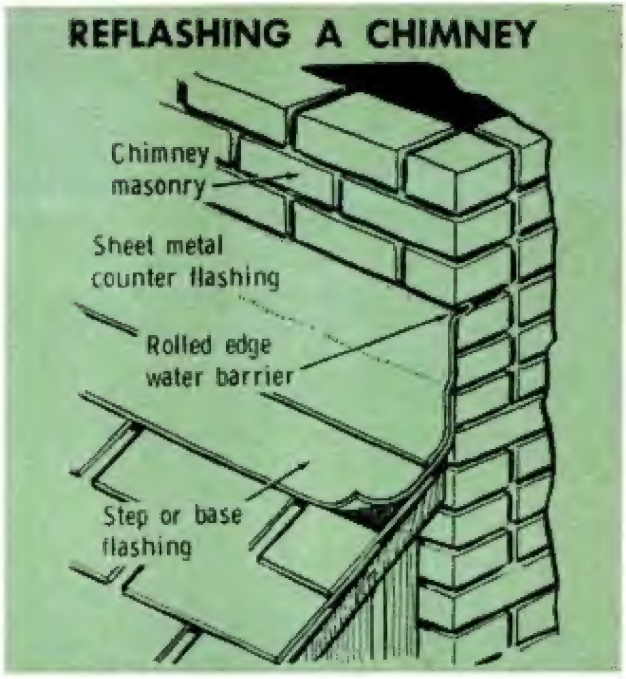
So much for the range of choice you'll have if gutters need replacing, or if you build a new house. (Incidentally, if you're planning an addition, don't use a different type of gutter along the new roof. Should you ever tie aluminum into a steel system, for example, you'd be inviting corrosion.)

Now let's climb up for a look at your present gutters. Whatever the type of system, it can't do its job if it's clogged with leaves and other debris. Not only will water back up and overflow; a mass of soggy leaves is heavy, adding weight the gutter hangers weren't designed to support. This can cause sagging, and it's much easier to clean a gutter out than to repitch it.

Proper pitch (about $\frac{1}{16}$ in. per running foot) is vital in wood and steel gutters, less important with aluminum and plastic, where standing water won't cause deterioration. However, prolonged "puddling" can invite stagnation and insect breeding, so it's always best to keep the run-off flowing. Checking pitch is easy: just pour a bucket of water in the trough and watch how it drains. If it puddles in one spot, adjust the hanger nearest that spot to raise the gutter.

The ease of this job depends on the type and number of hangers you find up there. Hangers are usually placed about every three feet, and maybe your sag problem results from too wide a spacing. In such cases, adding a hanger may correct the sag.

The many varieties of hangers (and we've only shown a few on page 159) break down roughly into two categories —those that nail to the fascia board or rafter ends, and those that drop from the edge of the roof because there is no fascia or exposed rafter to nail into. The latter types have a vertical rod with a flattened end which must be bent to conform to the roof pitch. The bent end is then anchored under the first course of shingles. Whatever the hanger design, it must be of the



TO KEEP JOINT SEALED between wooden roof and masonry projecting through it, flashing anchored to roof and that attached to chimney are separate pieces

SHEETMETAL FLASHING had opened at corner seam and top mortar joint was crumbling, so black plastic cement should be liberally applied at critical points

TO REINFORCE leaky flashing, wrap asbestos felt or fiberglass around it, cut to conform to roof angle. This is easier with several pieces, lapped at corners

REFLASHING A VENT PIPE

VENT PIPES are too rigid to accommodate themselves to a house's settling. To reseal gaps between pipe and base, apply plastic cement

MAKE SERIES OF CUTS along one edge of asbestos felt or fiberglass flashing strip and draw it around base, seating it in cement

WRAP STRIP TIGHT, pressing tabs firmly into cement and overlapping ends. Follow with a top coating of cement for a waterproof seal

same metal as the gutter, and should be attached with nails of the same metal.

Hanger adjustment isn't, of course, possible with wood gutters, which are nailed right to the fascia board through spacer blocks. Correcting pitch involves knocking the gutter loose and renailing. If you try this, be sure to replace those spacers; without 'em, water can seep up under the shingles and drain down inside the wall —or at least drain down the joint between gutter and fascia, inviting mildew and rot.

If clean-out is a chore you'd rather avoid, those gutters should all be capped with a guard that lets the water through but screens out debris—leaves, twigs, bird nests and anything the kids might toss up

(Please turn to page 210)

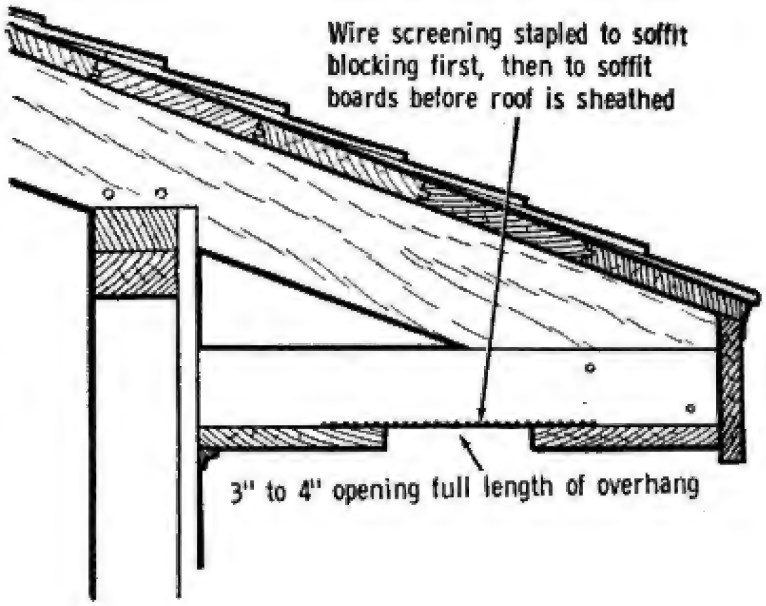
FLASHING A ROOF JOINT

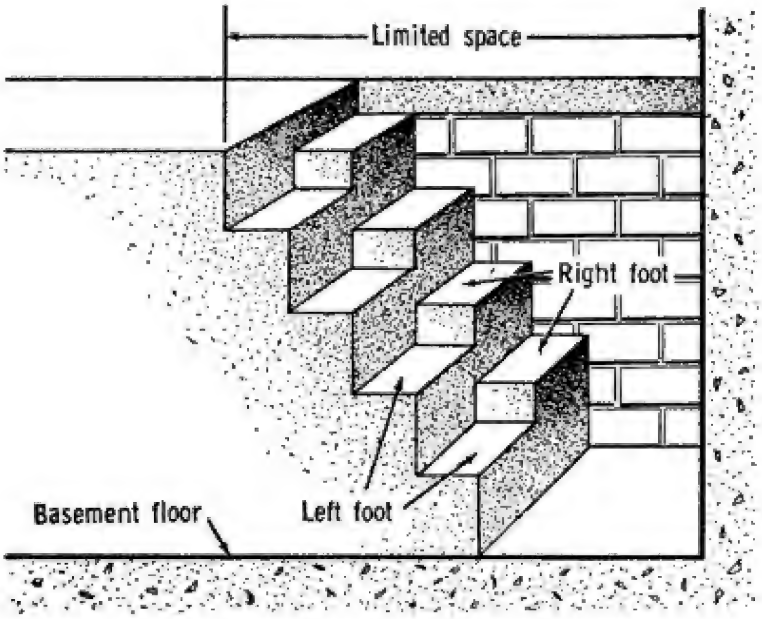
Any break in the shingle treatment—as in a valley where two roofs meet, or where there's an offset roof, as shown below—presents a potential leak problem. The answer is always flashing. To seat a strip of asbestos felt across the gap, first apply black plastic cement, extending about two inches on either side of the joint. Press the material firmly into the corner, trimming ends as needed and taking care that ends are anchored

Clever Solutions to Building Problems

Soffit Venting

When building a shed or other small structure, you can provide low-cost ventilation by using edge trimmings from fly screen for cornice soffit venting. Just staple strips of screen to soffit framing midway between wall and edge, install soffit boards, leaving screen exposed and staple edges of screen to soffit boards before applying roof sheathing.



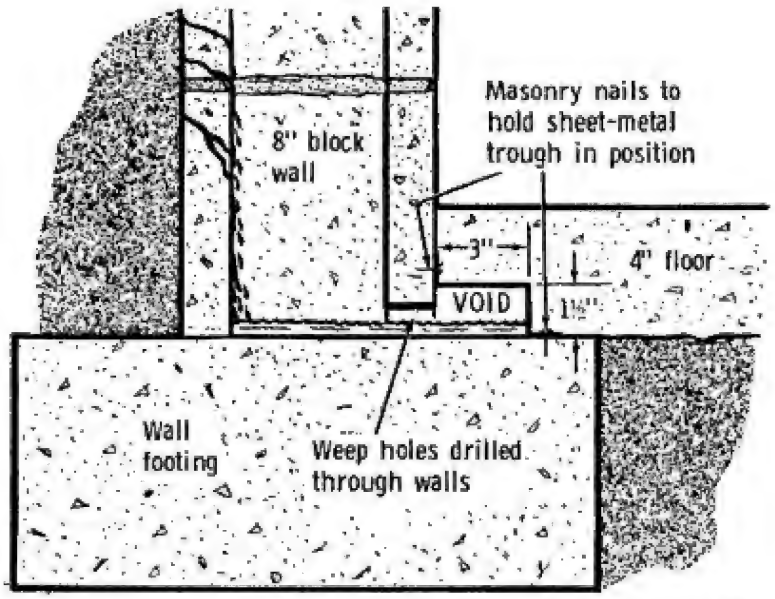


Space-Saving Stairs

Don't settle for steep, hard-to-climb stairs in cases where horizontal space is limited. Instead, construct your stairs with two risers per step forward, as shown at left. This same design will work just as well in wood, and might come in handy for stair access to an attic through an existing closet.

Hidden Basement Gutter

If you're building a house with a block foundation, have a local sheet-metal shop make up troughs, as shown at right, and install these on top of the footings next to the walls before the floor is poured. These should lead to a sump. Such a drainage system will take care of any seepage which runs down through the hollow-core blocks.

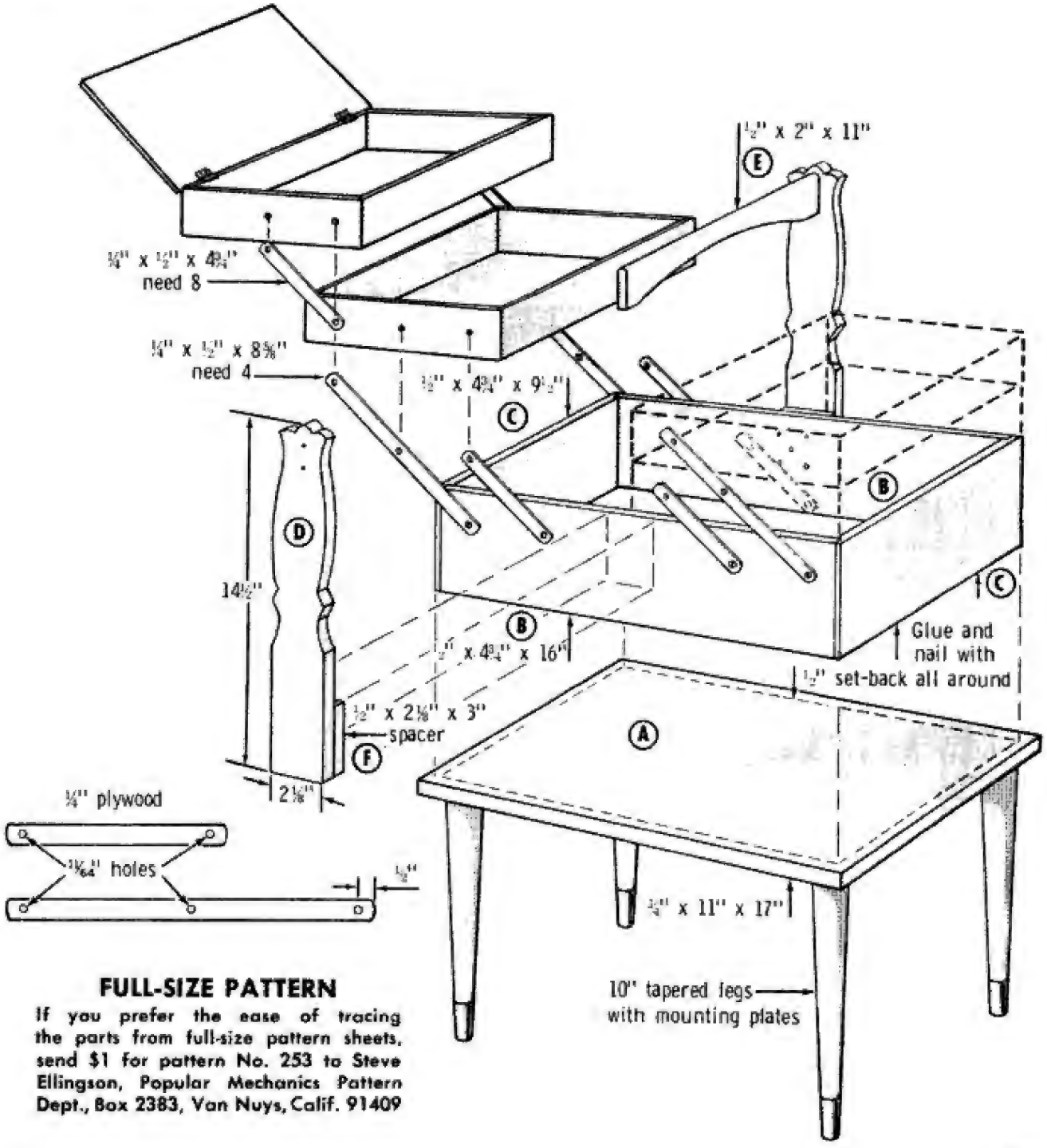


Swing-Out Sewing Caddy

IF THIS CABINET could reach out and hand you the very sewing item you're looking for, it couldn't be more helpful. For when it's swung completely open, the entire contents are immediately displayed, in neat regimental array, for easy selection. When closed, its linked-together trays stack into a neat storage stand, with a pick-up handle that lets you tote your whole sewing center to your favorite chair or the best light for working.

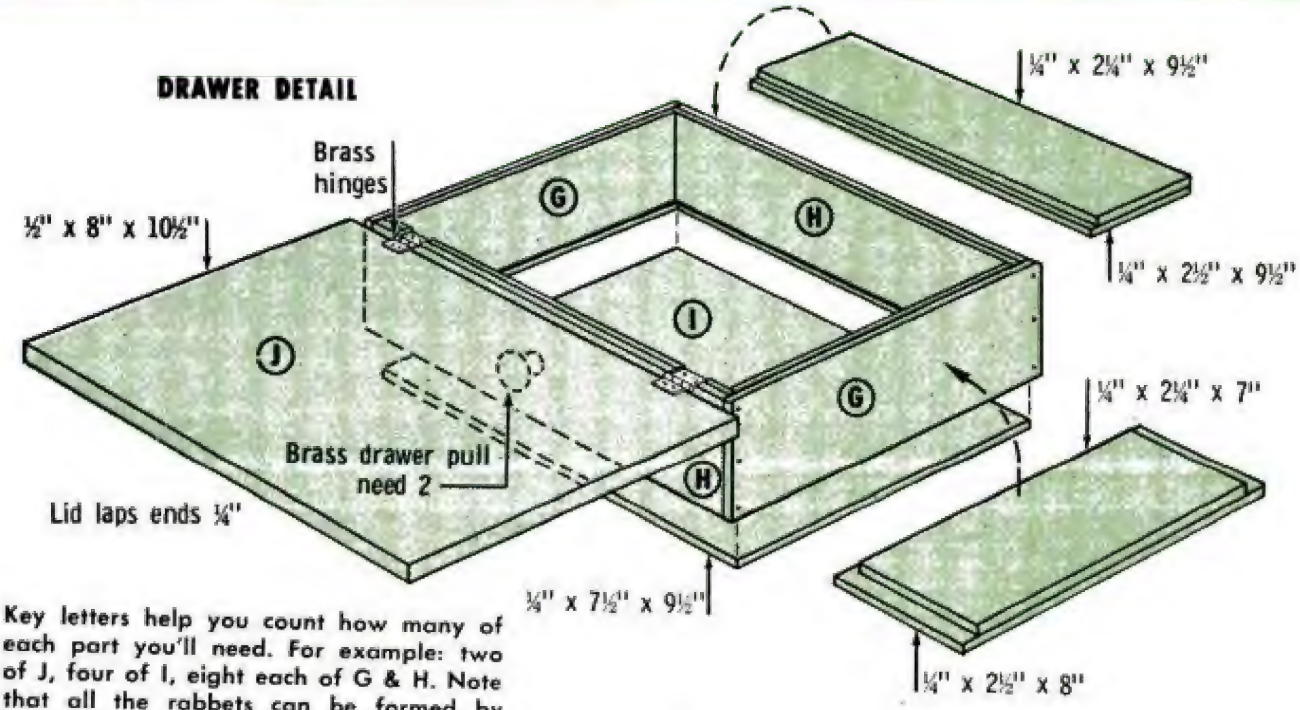
The bottom compartment has plenty of space for patterns, fabrics or bulky yarns. The four smaller trays store threads, scissors, needles, buttons—and all the other small items that get lost in a conventional drawer. The trays can be further compartmented to suit your supplies.

Stack the trays to form a box and position the links, driving tacks through their holes into parts B and G; then swing each section open to see if the links offer proper support. When adjustment is set, drill pilot holes in B and G. After finishing, drive ¾-in. No. 8 r.h. screws so they're snug but don't prevent pivot.—*Steve Ellingson*



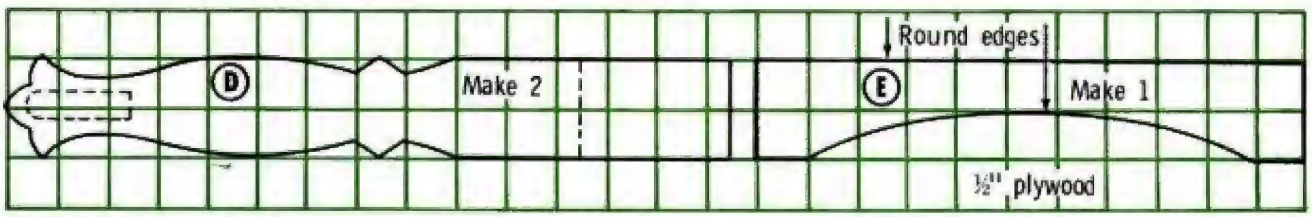
FULL-SIZE PATTERN

If you prefer the ease of tracing the parts from full-size pattern sheets, send $1 for pattern No. 253 to Steve Ellingson, Popular Mechanics Pattern Dept., Box 2383, Van Nuys, Calif. 91409



Key letters help you count how many of each part you'll need. For example: two of J, four of I, eight each of G & H. Note that all the rabbets can be formed by gluing two plywood pieces face-to-face

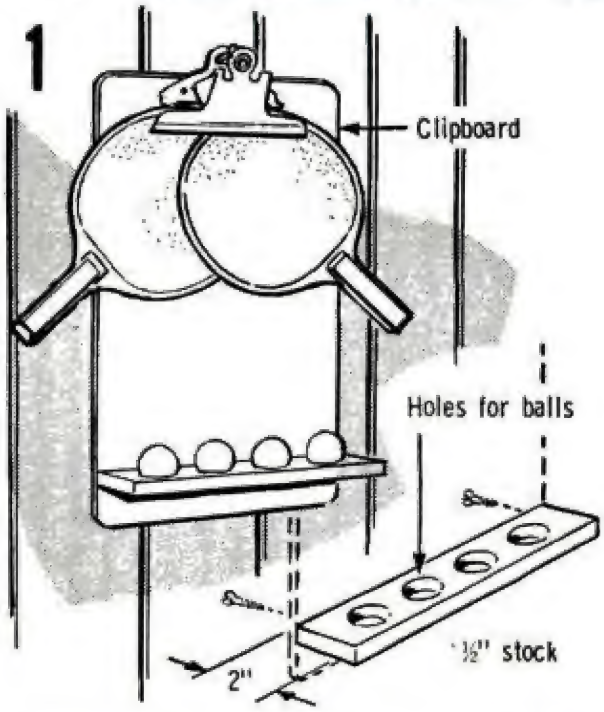
1" squares



SOLVING

HOME PROBLEMS

1. WALL CADDY for table-tennis paddles and balls can be made by mounting a ball rack on an ordinary clip board. Paddles slip under clip, which may be padded with strips of rubber or felt, if desired



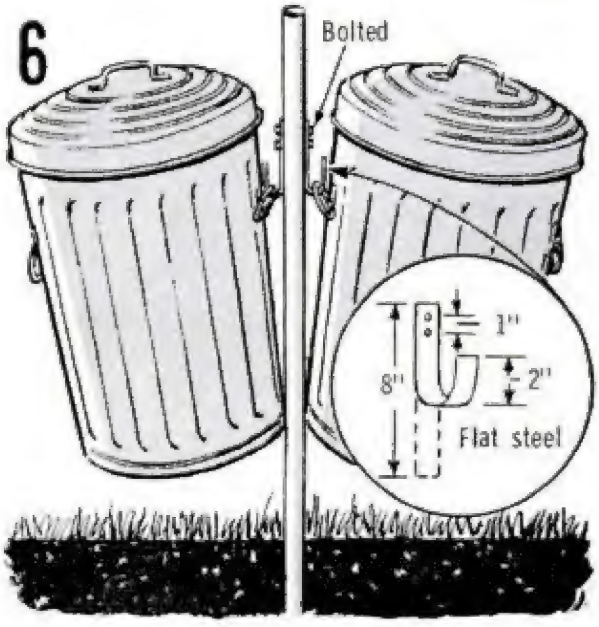
2. SELF-LEVELLING shelf for any hollow-rung metal ladder swings freely on a 1-in. dowel inserted into end of rung. A 9 x 12-in. shelf will be large enough to hold most paint cans, brushes and tools

3. WHEN SQUEEZE BOTTLE of glue is almost empty, turn it upside down and store it in a tool rack. This keeps the glue up top, ready to use, and does away with wait while glue is squeezed up to the spout

4. IT'S EASIER to remove nut meats whole from their shells if the nuts have soaked overnight in salt water before cracking. The water expands the shells, while the salt prevents the meats from losing flavor

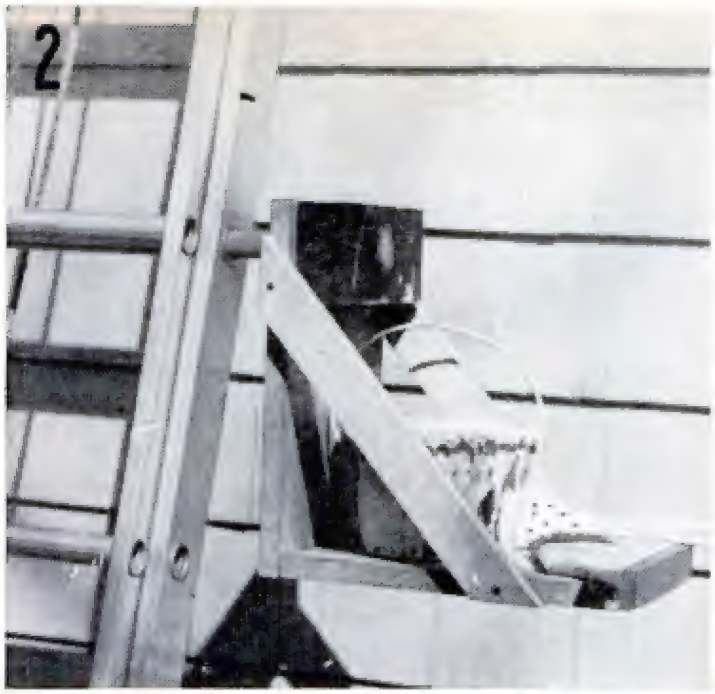
5. POURING SPOUT for dry materials is a handy addition to mason jars in which salt, sugar, flour, etc., are stored. Just cut the top from cardboard container in which salt is sold and mount it with a jar ring

6. POLE HOLDER designed for two garbage cans not only doubles life of cans but defies overturning by wind or animals. Place hooks to hold cans 6 in. above ground and drill drainage holes in can bottoms



7. ARTISTS' BRUSHES will last longer and stay softer if you smooth the bristles to a point with petroleum jelly after each cleaning. Naturally, each brush should be thoroughly cleaned right after you use it

8. DECORATIVE PANEL to relieve the monotony of a long panelled wall can be made by mounting patterned perforated hardboard on wall and framing it with molding. Use contrasting color on background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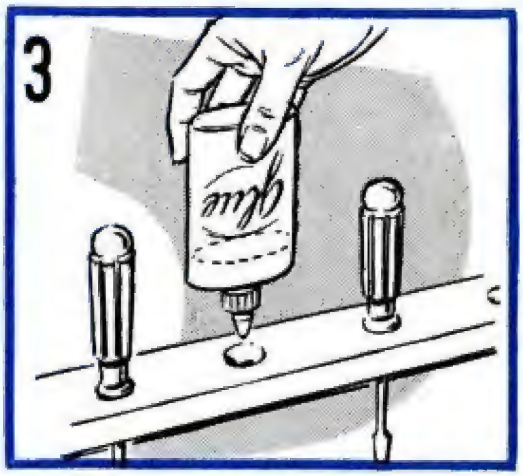
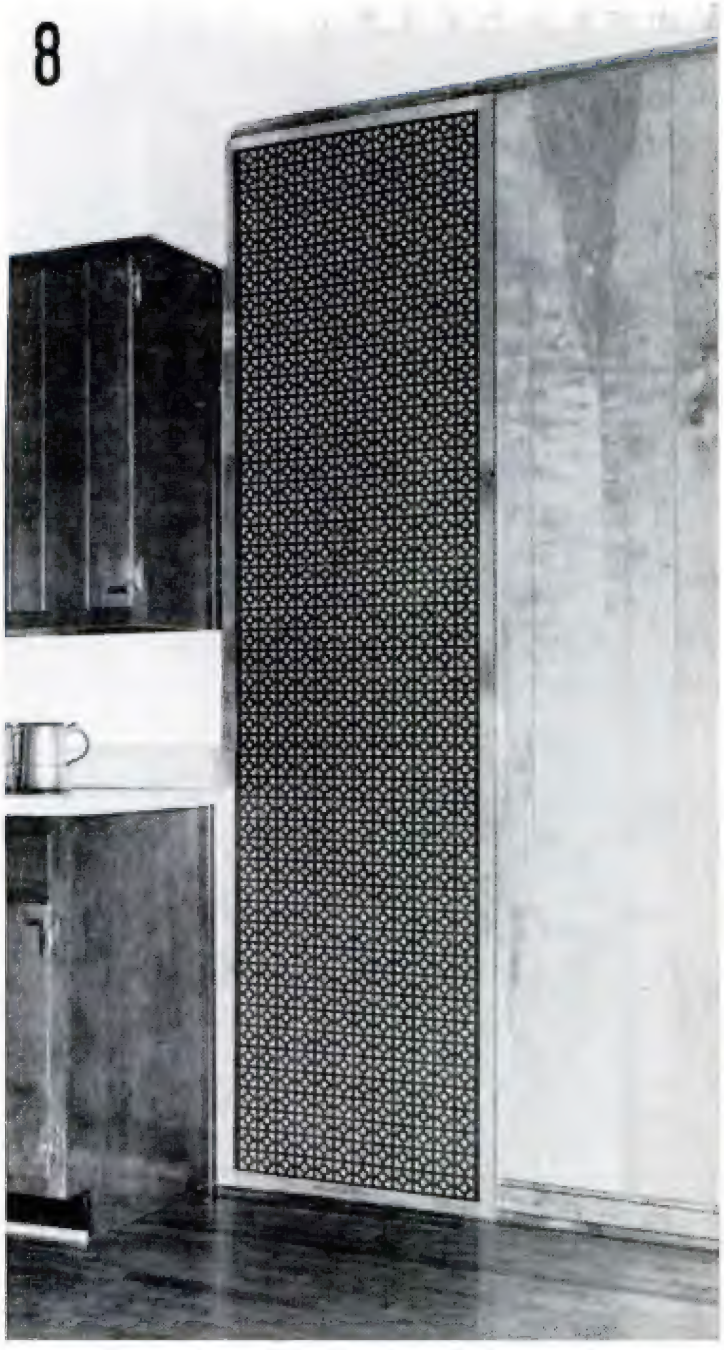
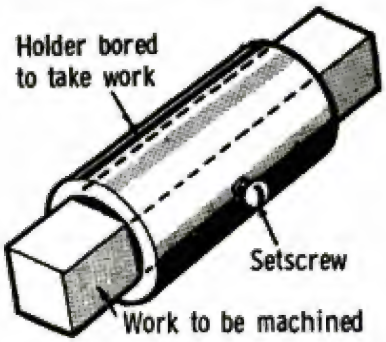

3
glue

5
SALT

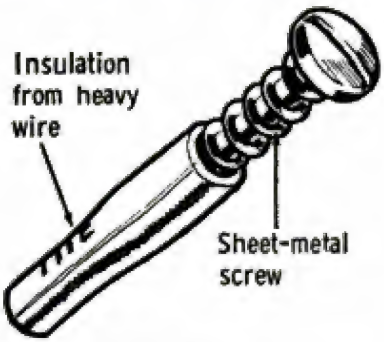

8

7

TAKE A HINT FROM READERS

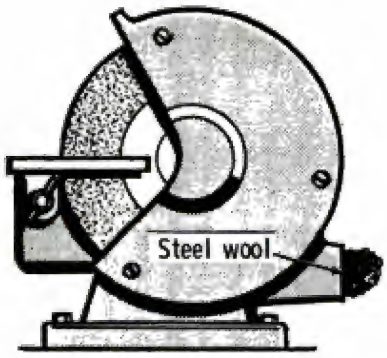


SAVE CHUCKING TIME when drilling and taping ends of mass pieces of square stock by boring out round rod for snug fit for square rod, adding a set-screw and chucking the fixture in lathe



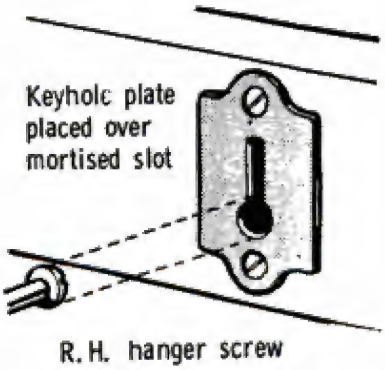
YOU CAN IMPROVISE a screw anchor from the insulation on No. 6 or 8 wire by snipping off a 1-in. length, pushing out the wire core and placing the insulation sleeve in hole in wall

IF YOU BREAK a ⅛-in. drill bit, you can make an excellent on-the-job substitute from a spiral nail. A headless floor nail chucked into the drill works great even in drilling hardwood

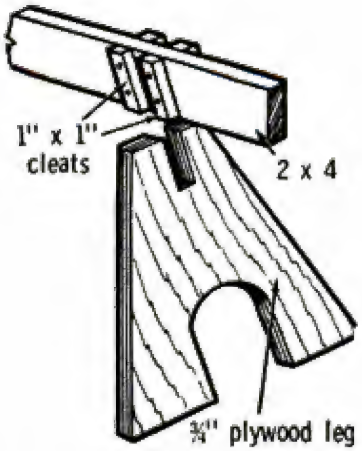


STEEL WOOL makes an efficient throwaway grit catcher for the exhaust chute on your bench grinder. A wad of it stuffed into the chute will trap grit while allowing air to pass through

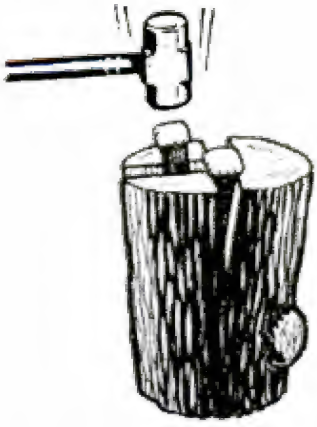
PADDED MEMBERS on a sawbuck will prevent skinned knuckles when sawing firewood. Pad them by tacking pieces of inner tubing over the ends of the crossed uprights of the log cradle



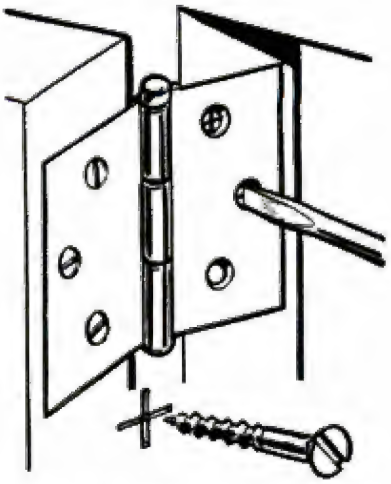
HIDDEN HANGER for a picture frame can be made by mortising a vertical slot in the center of the frame and covering this with an inverted keyhole plate to fit over hanging screw on wall



COLLAPSIBLE sawhorse made from a length of 2 x 4 and ¾-in. plywood is strong and sturdy but comes apart easily for storing. Make it as shown, with dimensions to suit your needs



WHEN SPLITTING wood with a wedge and sledge, the wedge often becomes jammed in the log. If this happens, use another wedge to split one side of log and free bound wedge



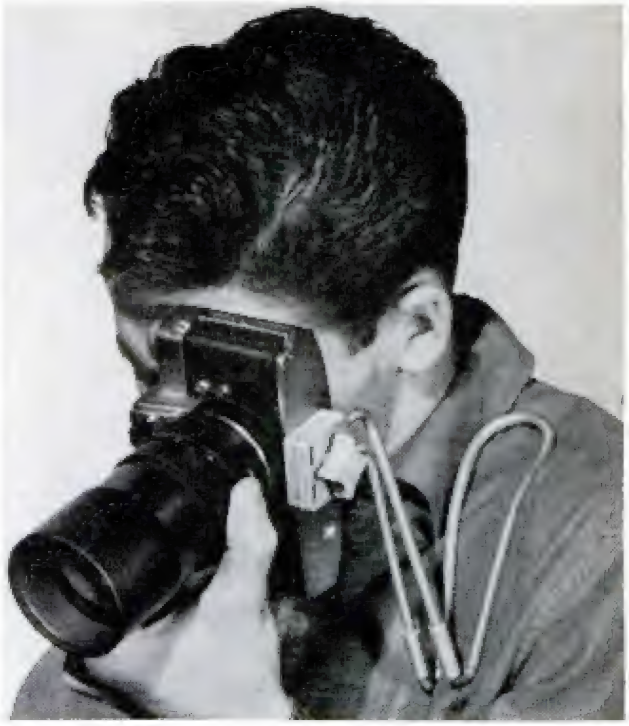
SCREWDRIVER blade which matches the diameter of holes in hinges is the perfect tool for marking drilling centers. Tap it once, turn and tap again. The "X" produced marks the center

NEW FOR

CAMERA BUFFS

BY ROBERT B. BERGER

You can carry your camera or binoculars comfortably and securely—even at a trot—with the Camera Caddy. This heavy-duty elasticized strap holds the camera under tension to prevent swinging and dangling, and also helps to steady the camera for sharp, hand-held shots. It is available in most photo shops for $3.95. Sloan Marketing Corp., Ardmore, Pa.



Small accessory with a long name is the Schiansky Staticfix shoulder brace. Though not intended as a substitute for a tripod, the brace lends a great deal of support when shooting with heavy telephoto lenses. When not in use, it may be folded and carried in the pocket. Cost is $5.95 postpaid from Uniphot Inc., 1270 Broadway, New York, N.Y. 10001.

Any focal length from 85 to 210mm can be set when you use the Sun Zoom lens. The lens is only 6¾ in. long and weighs 20 oz. Maximum aperture is f/4.8. A complete line of adapters is available so that the lens may be used on any 35mm SLR having a focal plane shutter. Priced at $99.95 with case and lens shade. Spiratone Inc., 135-06 Northern Blvd., Flushing, N.Y.

Candids are a snap with the Olympus Pen W. This compact, half-frame 35mm camera is fitted with a 25mm f/2.8 wide-angle lens; shutter speeds range from ⅛ to 1/250 sec. Special features include a luminous frame viewfinder, visible from edge to edge even when wearing eyeglasses. The price is $49.95. Scopus Inc., 257 Park Ave. South, New York, N.Y.

Pattern Your

W. Clyde Lammey

AT THE PATTERN BOARD shot charges that register consistently high, low, right or left of center can tell you a story of shotgun fit. In practice you don't aim a scattergun as you do a rifle and this is why correct shotgun fit is just as essential, perhaps even more essential to high score shooting, as is rifle fit. In shotgun handling one must move fast. Only speed, coordination and proper gun fit count when at most you have only seconds to get off a shot that connects. This is why one should pattern every shotgun he owns, whether these be newly acquired, or old, untested favorites.

If, for example, you are shooting a scattergun with a stock a bit too short for you, you may find on pattern-board testing that the charges register consistently to the right of center and possibly a little low. On the other hand, if the stock pull length is greater than you require individually, you may discover that the charges tend to pattern a little to the left of center and likely a trifle high, assuming, of course,

FIRE ONE SHOT at each patterning sheet, then either count number of pellet holes at the time, or number or otherwise mark sheet for later reference

ALTHOUGH STANCE is important, it should be relaxed and natural as suits individual, forward knee slightly bent, cheek well down on comb. Wear field clothing

Shotgun

When you swing your shotgun on live or clay birds it's important to know where the shot charge goes

you are right-handed. In either case the bird is likely to be caught in the fringes of the shot pattern or may be missed entirely. If the stock drop is too great, you may find the charges landing consistently low and if the stock is too straight for you individually, the charges may register consistently above center. There are, of course, other factors governing gun fit but these variations usually are considered primary.

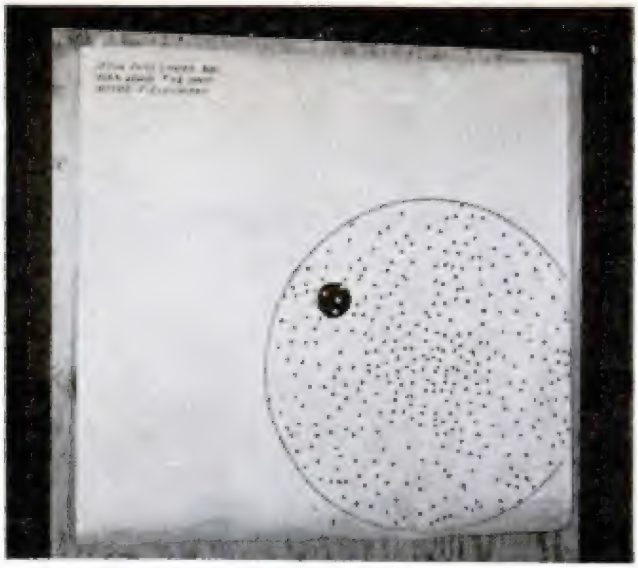
Patterning is a simple procedure but one must be prepared to burn considerable ammo in order to arrive at definite conclusions. You'll need the pattern board and quite a number of sheets of paper roughly of the size and dimensions detailed, the paper sheets each having a bull's eye or bird outline as an aiming point. The pattern board should be set up before a steep slope or in some other location where it is safe to fire a shotgun. A distance of 40 yds. from the pattern board is the generally accepted range for testing full choked 12, 16 and 20-gauge shotguns. The smaller

SIMPLE SETUP for firing from rest. As safety measure when firing varying gauges use varicolored shells, red for 12, blue for 16, and yellow for 20 gauge

ANOTHER VIEW of what is generally accepted as proper stance for offhand firing at pattern board. Dry firing can be of help in taking the stance quickly

TO DETERMINE pattern uniformity, also percentages, scribe a 30-in. diameter circle around greatest concentration of pellet holes. See detail for scriber

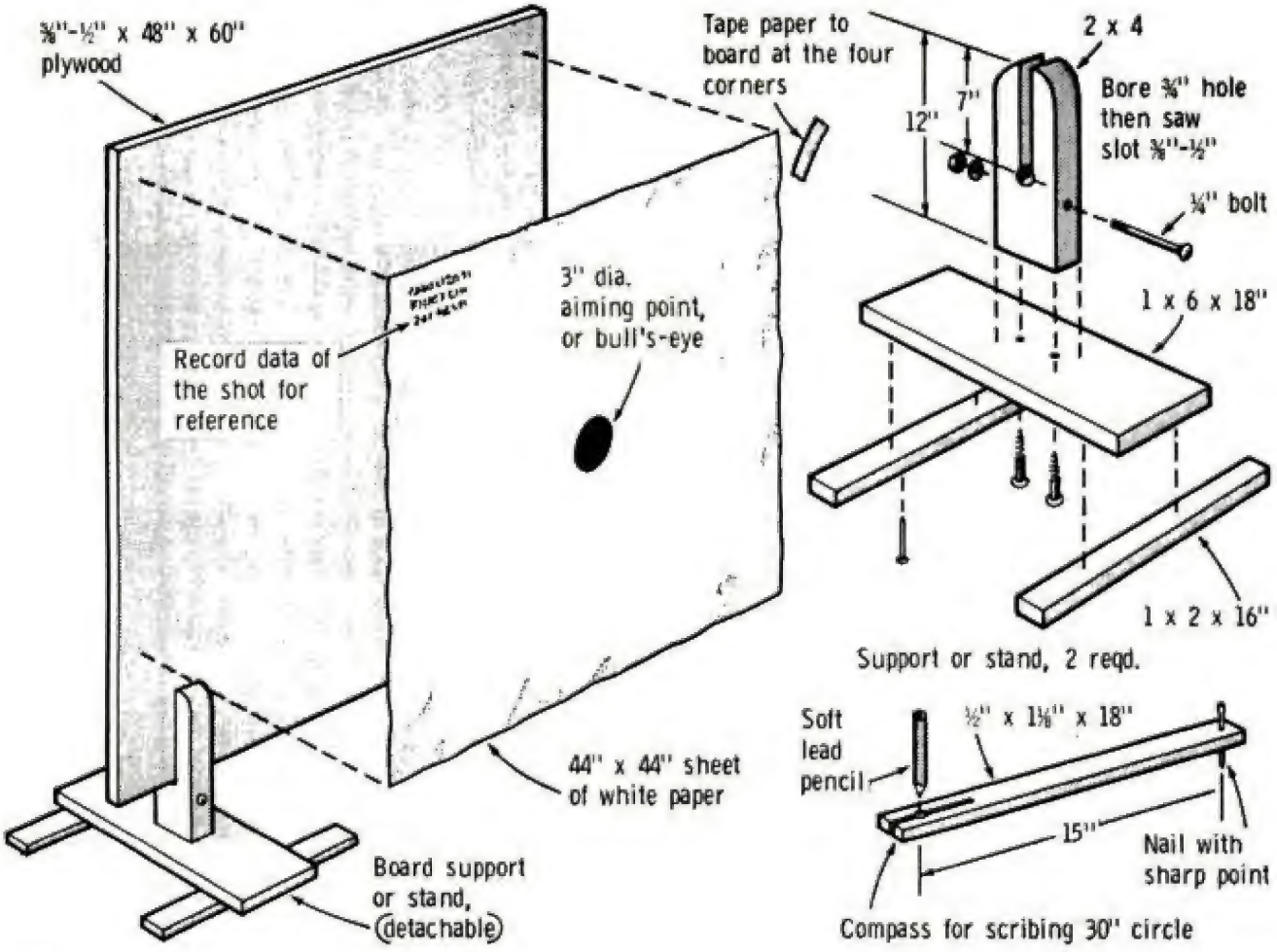
CHECK NUMBER of pellet holes inside circle, using felt marker, counting as you go. Number of pellets may vary shot to shot, but average should be fairly close



IF YOUR GUN STOCK is too short you may find shot charges registering consistently low and perhaps a little to the right as indicated by this pattern

gauges, 28 and 410 bores, also the more open borings in the larger gauges, are usually tested at shorter ranges. Make a mark or drive a stake at the 40-yd. firing position. Don the clothing you normally wear afield, for the first tests a light hunting shirt and jacket.

Move diagonally away from the stake a few steps to the right or left, then turn and approach the stake with the gun in the field carry position. On reaching the firing point mount the gun and fire quickly, without "aiming," just as you would at a moving target. The first trials of this maneuver may be difficult to bring off consistently as you will be more fully conscious of the gun, the target, and also of the fact that in this procedure the factors of gun swing and lead have been eliminated. But if one persists—dry runs may



help—in the maneuver, it's possible to duplicate a typical field stance and to carry out gun mounting and pointing with a consistency and accuracy sufficient for the purpose. Fire only one shot at a time and carefully note the position of the charge as tagged by the pattern paper. Then remove the paper, replace with a fresh sheet and repeat the performance until a consistency in placement of the charges becomes unmistakably evident. All charges may continue to land on center—allowing for inaccuracies in pointing—or they may tend to land right, left, high or low.

Before you make any corrective stock alterations, such as lengthening or shortening the pull length, or raising or lowering the comb height, change to heavier clothing such as you would wear in cold weather, and run another series of test shots. It's likely you will turn up some variations, using the same gun and ammo. As an example, if your gun places its charges consistently to the right and low you may discover that when you don heavy clothing the charges tend to land on center, give or take a little. In this case the extra thickness of heavy clothing has, in effect, lengthened the stock. Should the stock be a little too long, you may find you're throwing charges halfway off the board when you're heavily clad. Usually there's less variation when the gun tends to throw charges high or low of center consistently, but you may detect some variable even here when comparing the effect of light and heavy clothing.

On discovery of any of these variations you have two corrective choices: either alter the stock as required or adapt your shooting practices to correct the tendency. The latter can be done with practice in handling. You can raise the comb if required with a lace-on type pad. The stock can be lengthened with spacers placed under the buttplate or butt pad. Other stock alterations involving reworking the wood, such as thinning the comb, should

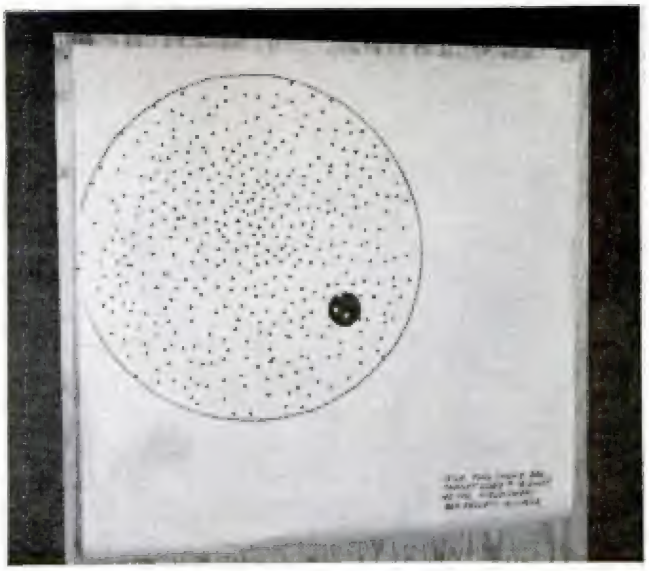
(Please turn to page 209)

AVERAGE NO. OF SHOT PELLETS IN COMMON LOADINGS*

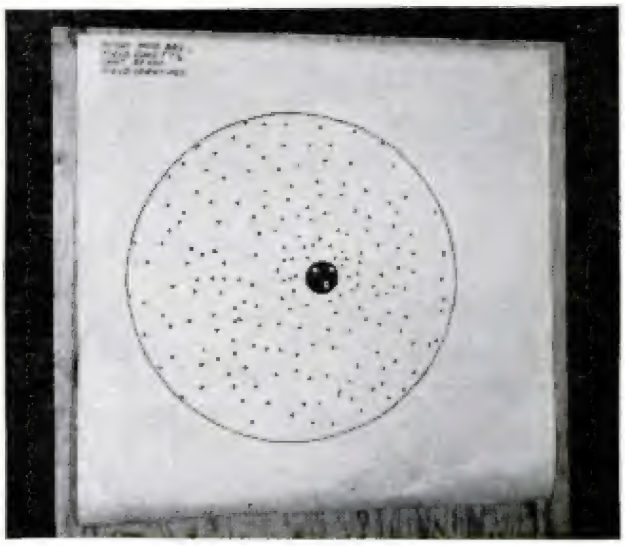
Weight of charge in ounces

Shot Size	¾	⅞	1	1⅛	1¼
9	439	512	585	658	731
8	308	359	410	462	512
7½	263	305	350	394	438
6	169	197	225	254	281
5	128	149	170	191	213
4	101	118	135	152	169

**Figures are only approximate for the number of pellets for each shot size.*



ON OTHER HAND, if shot charges consistently land to the left and high, the stock may be too long for you individually. Gunsmith can correct at nominal cost



PATTERN showing uniform distribution of pellets from 20-gauge modified choke barrel at 35 yds. Concentration is to left, likely a pointing error

PATTERN FROM 410 BORE insert in 12-gauge full choke barrel at range of 25 yds., using No. 9 shot size. Charge is centered and rather tightly concentrated

Motorized Humidifier

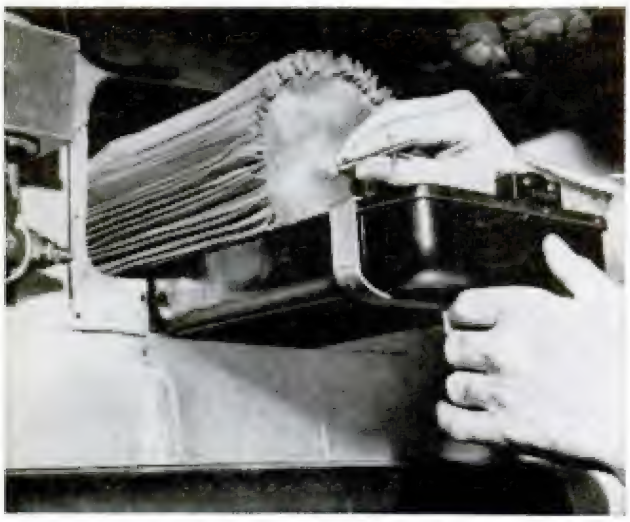
Furnace humidifiers are seldom part of the they're usually the better-than-none plate type. matic humidifier that requires only minimum

By Frank L. Greenwald

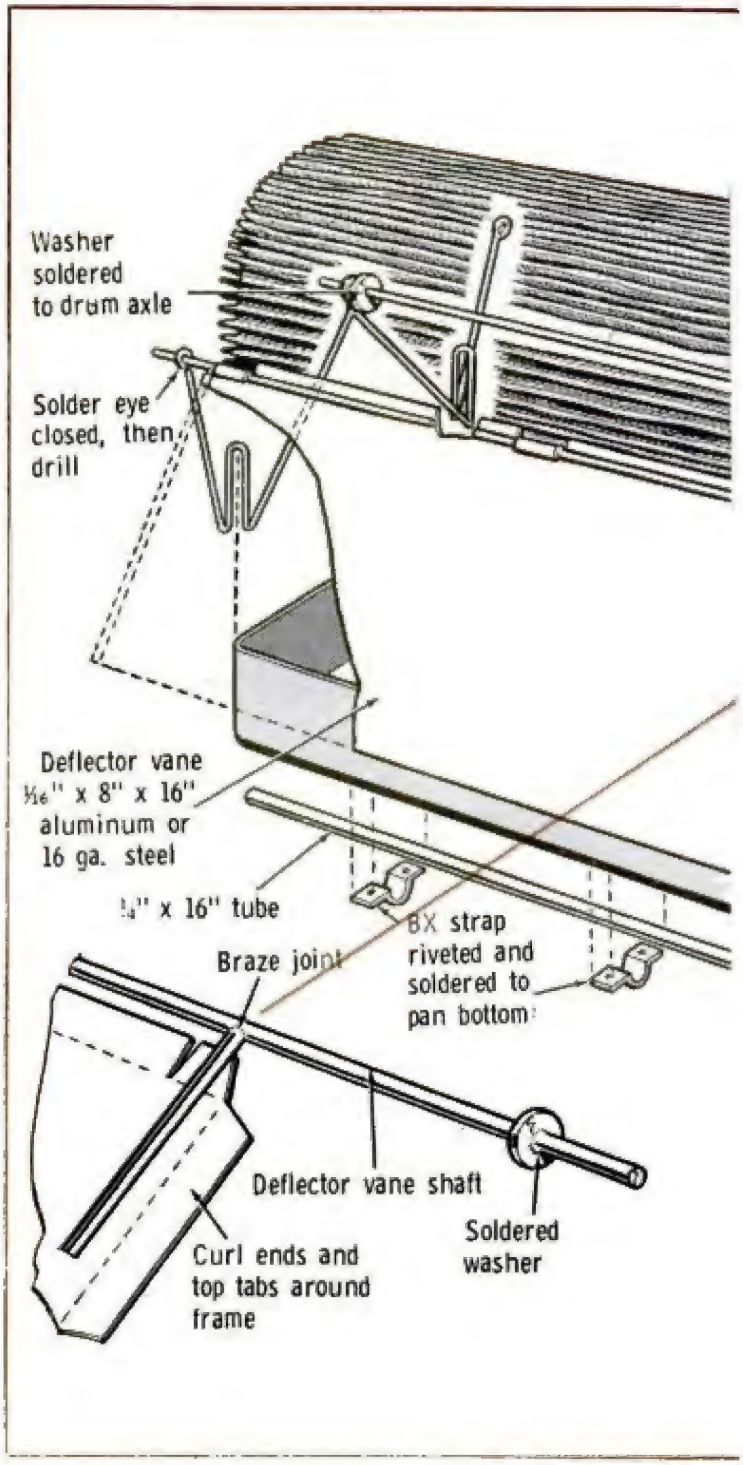
MOST FORCED-AIR FURNACES that come with any humidifier at all are equipped with the simple evaporative plate type which is the least efficient of the many in-plenum designs available. It consists of stationary blotter-like plates that suck moisture up from the water pan they stand in. The theory is that exposing all these moist surfaces will help the hot air pick up water vapor as it passes. The trouble is that these plates quickly clog with mineral deposits—especially in hard-water areas—and the amount of moisture they supply is woefully inadequate for most homes.

The result? The dried-out air that flows into your rooms is so thirsty it grabs moisture from everything it touches: furnishings, fabrics—and *you*. Rapid evaporation from your skin makes you feel so cold you turn up the thermostat—and up goes your fuel bill, as well. (For a full discussion of the need for home humidification, see *"There's Danger in Desert-Dry Air,"* page 158, Dec. '63 *PM*.)

What's needed in every forced-air furnace is a constantly replenished supply of moisture, and one of the best ways to provide this is by means of a drum that rotates through a reservoir, picking up droplets of water—a drum through which the hot, dry air can readily pass on its way from the furnace to the rooms of your home. Hot air can hold a lot more moisture than cold, so the heated air your furnace sends out needs access to a large amount of water. But air can suck up moisture only by direct contact, and the *more* contact you make possible, the more moisture



INTO THE PLENUM of your furnace goes a pleated-screen drum that turns through a water pan to lift moisture—by evaporation—into the warm air stream

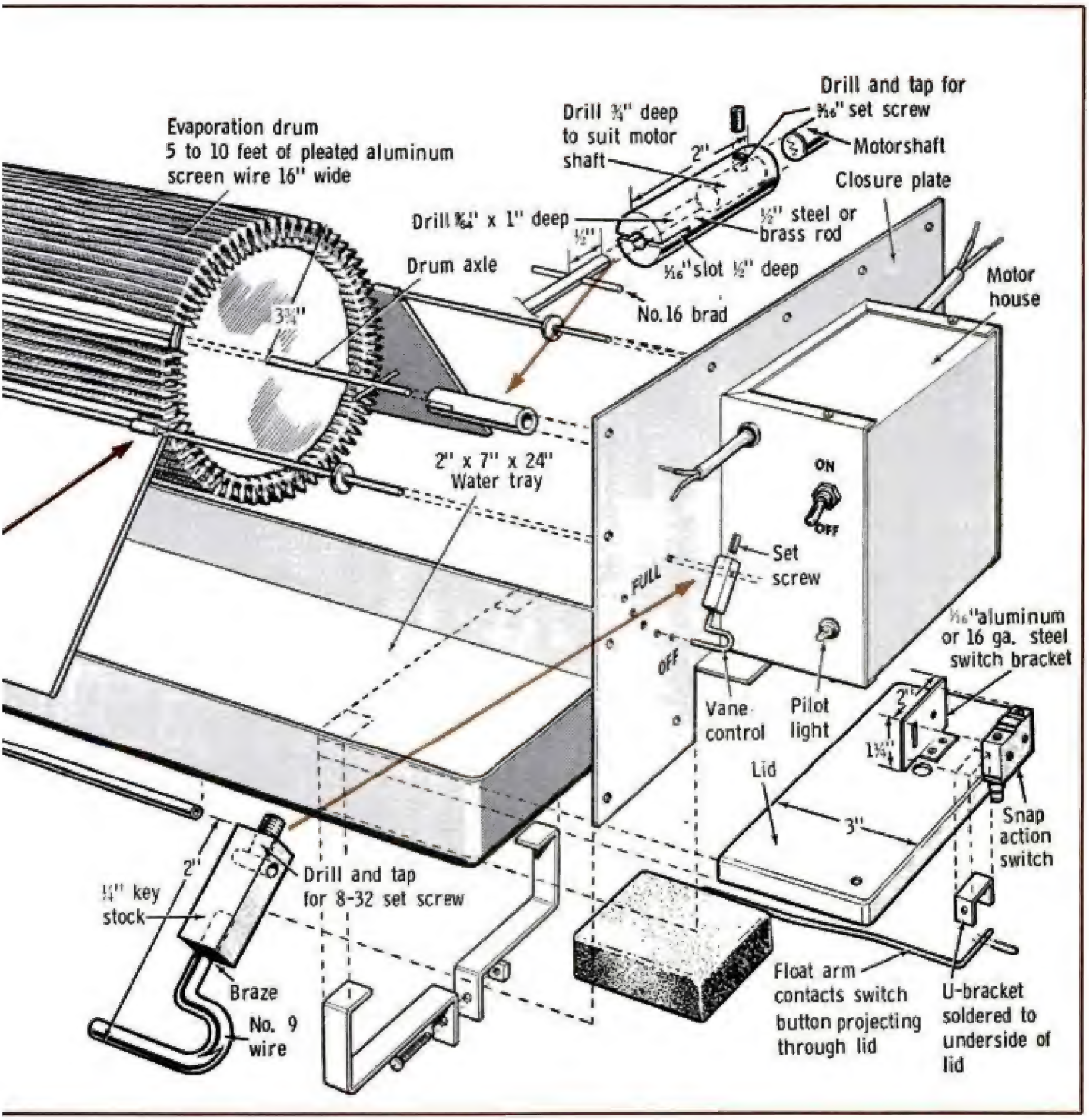


for Your Furnace

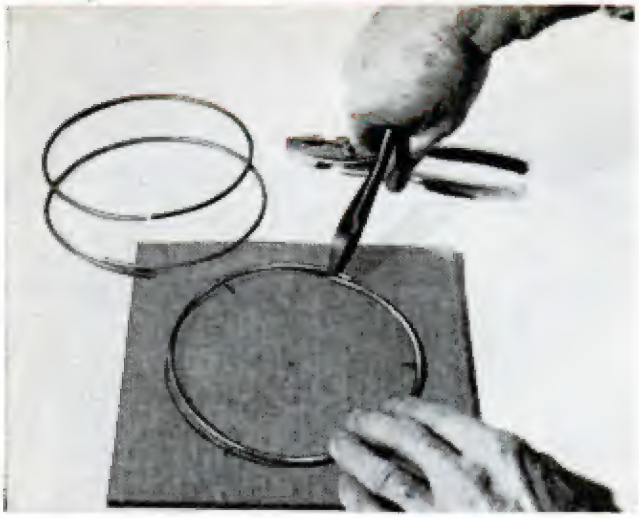
original installation and, where they are. Here's your chance to own an efficient auto- attention to keep heated air properly moist

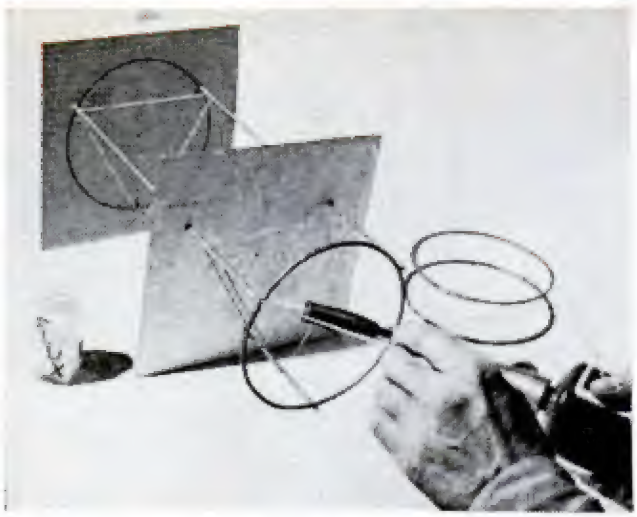
the air can absorb. A plain pan of water presents only an inert surface, and relatively little air actually touches it. But when you direct a great mass of heated air through a constantly-replenished mesh of droplets, the air's ability to absorb is much increased. And the *more* moisture it picks up in the plenum, on its way to your rooms, the less it will need when it arrives there. Of course, if you begin to find condensation on your windows, you must be able to *cut down* on your "moisture supplier" to avoid air that's *too* wet.

This principle is behind the humidifier



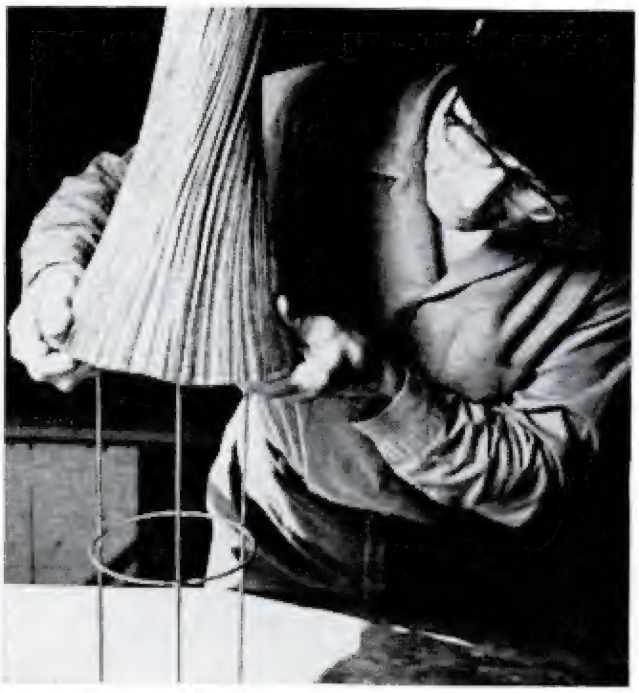
HOW TO MAKE THE EVAPORATIVE DRUM

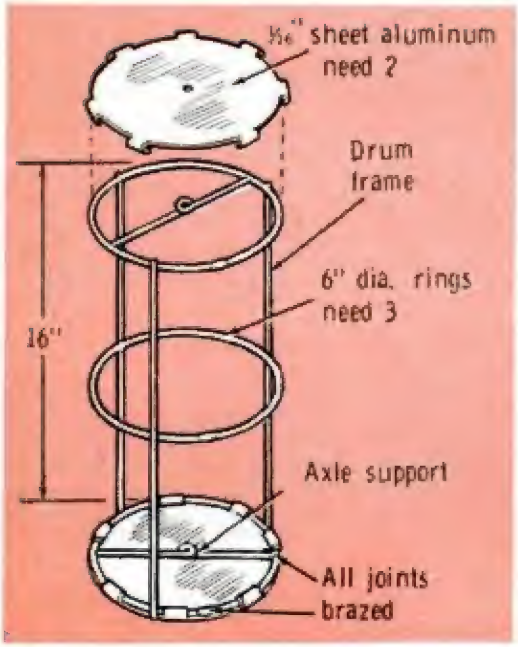




CARDBOARD TEMPLATES have circles marked off in three equal segments to serve as both bending guide (left) and assembly jig (right). Drum frame is No. 9 galvanized steel clothesline wire; bend three rings, snip off excess and braze butted ends before joining rings to struts held by templates and rubber bands as shown

FOLD ALUMINUM SCREEN into ¾-in. pleats, working toward center from each end. Note masking tape folded over raw edge to protect hands. Remove it before interlocking end pleats and fastening every inch with desk stapler. Slip resulting sleeve over frame, taking care not to stretch any more than necessary





that's shown here, and you can make it in a couple of evenings for a few dollars. It's capable of putting five to ten gallons of water a day into the air, and of raising the relative humidity in a seven-room ranch house to 35 percent at 74° in zero weather. What's more, it'll more than save its cost in one heating season by eliminating the purchase of new evaporater plates.

A drum covered with five to ten feet of pleated aluminum screening rotates at about 14 rpm in a water tray you'll probably be able to salvage from your present plate-type humidifier. Deflector vanes on each side can be adjusted to channel a certain portion of the forced air in at the sides of the drum and out through the top. A simple float mechanism operates a water valve by means of a snap-action switch, to keep the reservoir properly filled. And the drum motor only comes on when the furnace blower is operating.

There are no critical dimensions in the plans

presented here. The size of the components can be altered to suit individual needs. The *amount* of screening—in other words, the total number of pleats—isn't as important as the size of the drum frame. We tried two different drums of the size shown at lower left—one with five feet of screen, the other with ten; both had about the same evaporative rate.

If you can use your present furnace pan, and it has a float and valve in good working order, you've got a head start. Otherwise, you'll need a solenoid-controlled valve—such as one from an automatic washer. The valve shown in the photos was a homemade job, and I'd just finished it when I learned that local appliance repair shops could supply "half-good" valves for next to nothing! I have several with inoperable hot-water valve positions but a cold-water solenoid that works just fine. Such a valve would be ideal.

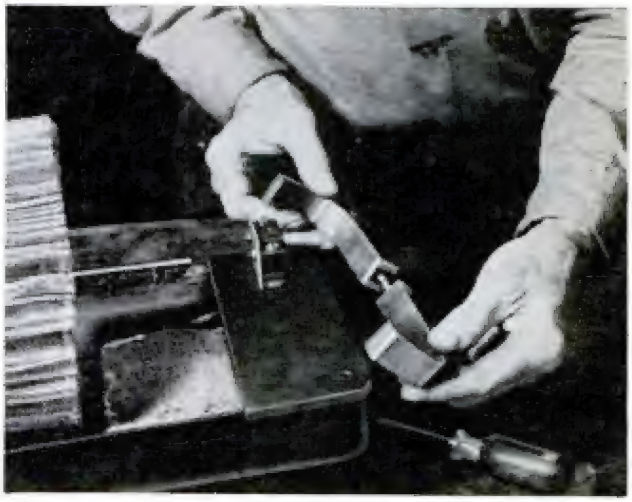
Start construction with the drum, after measuring your plenum and pan to determine the best size. Solder the drum to a clothesline-wire axle, allowing extra length at each end which can be trimmed off after fitting the drum in place. Finish the drum by closing each end with aluminum baffles to force the air-flow up through the moisture-laden screen. These are attached by friction tabs only.

Since my furnace pan had a porcelain enamel coating, I bent up a rear support bracket that would simply clip over the end without disturbing the rustproof finish. Solder a washer to the axle to act as a stop that prevents the drum from contacting this support. Trim the axle to within an inch of this stop.

My pan was equipped with a lid over the 3-in. portion that projected from the

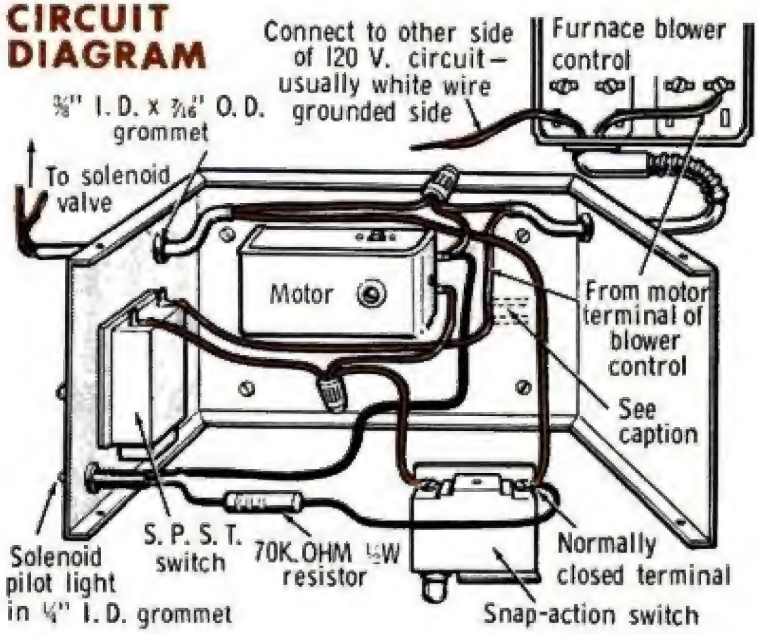
(For installation photos, please turn page; text continues on page 240)

WATER-LEVEL CONTROL consists of Styrofoam float on arm positioned to contact button of snap-action switch mounted on lid of water pan. Arm is locked in pivot bracket with a U of wire through two holes



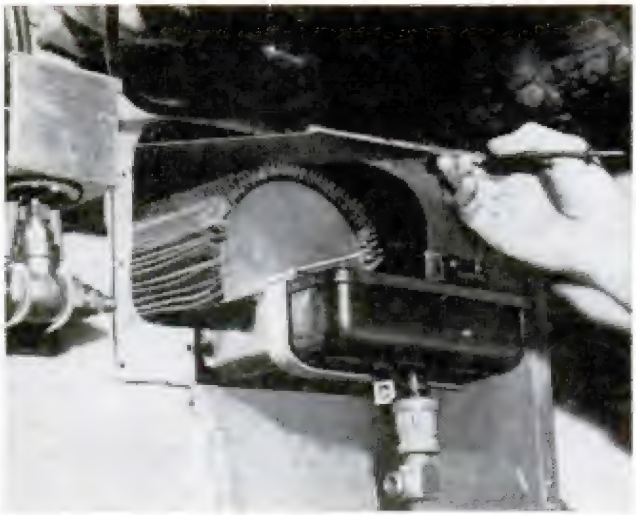
TWO-PIECE CLAMP is made from strip aluminum to hold part-lid on porcelain enamel pan. Join halves with bolt, slip clamp in place, tighten bolt. Where pan can be drilled, use screws through flange of lid

TO TURN DRUM, use any small reduction geared motor with 14-24 rpm shaft speed; three examples are shown. Since motor shaft acts as front support bearing, position it carefully in female half of minibox, which is screwed to closure plate after wiring as at right. Dotted lines show where 120-volt humidistat would splice into circuit if desired. Pilot light is also optional

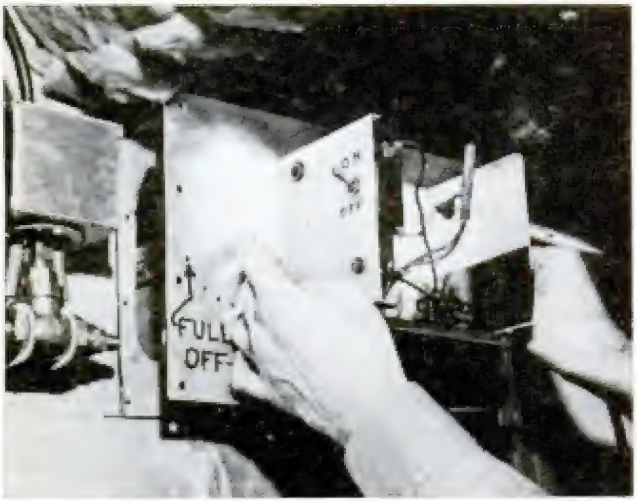


INSTALLING UNIT IN FURNACE PLENUM

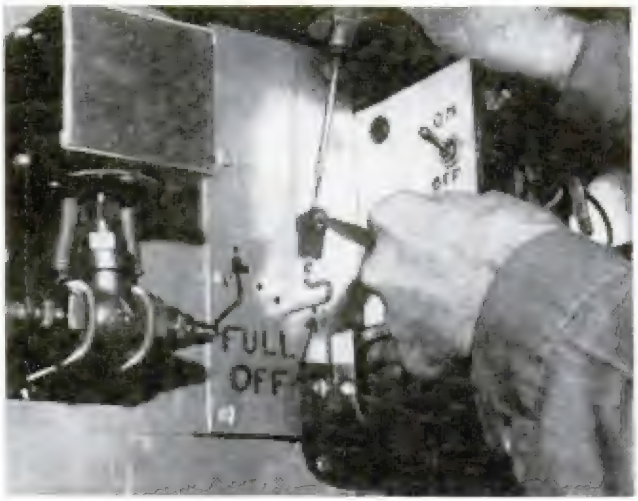
ACCESS OPENING must be enlarged to pass drum and vanes. Mark outline of closure plate around original opening, then trim with tin snips until large enough



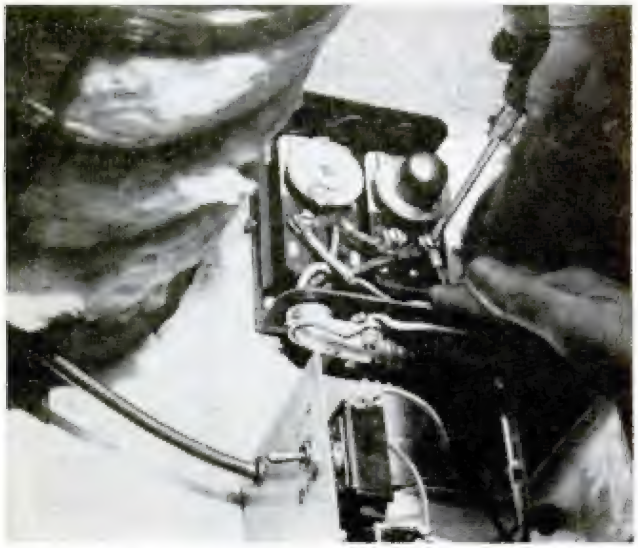
INSERT PAN about halfway, extending rear-support rod to engage its socket; insert drum axle and vane shafts into their rear support one at a time



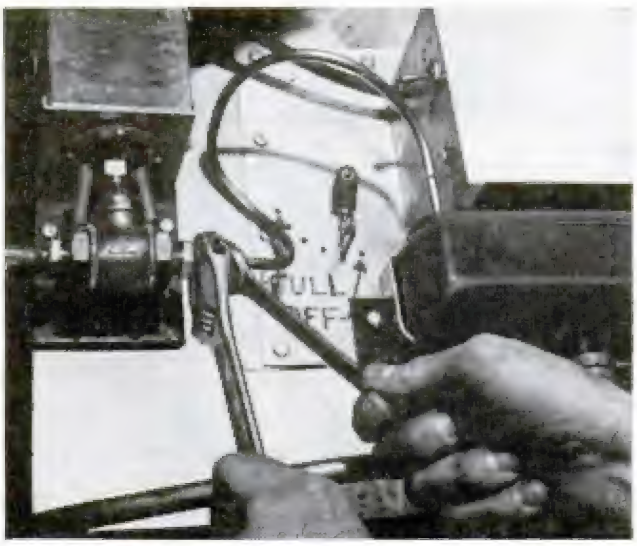
CLOSURE PLATE is tricky, since vane shafts must be fed through it and drum axle must be coupled to motor shaft. Once plate is seated, screw it tight



ADD VANE HANDLES by pulling forward on shaft while tightening setscrew against flat filed on shaft. Leave enough play to disengage positioning finger



BLOWER CONTROL unit on furnace is hooked into circuit so drum will revolve only when blower is on. Wire is connected to "motor" terminal of control



SOLENOID VALVE is connected to humidifier both electrically and with copper tubing that feeds water into pan when float arm trips snap-action switch

Don't Let Salt Do This To Your Driveway

TIME WAS when the only thing a town spread on its icy streets was sand. Now, however, calcium chloride and salt are widely used because they're active melting agents. They make for safer winter driving, but can spell trouble for your driveway; the salt slush clings to your car, comes home with you and drains onto your concrete. The scaling and pitting that results can ruin your garage floor or driveway in a single winter.

This can be prevented, however, by means of a simple treatment developed by Archer Daniels Midland, maker of Polmer-ik linseed oil. It's particularly recommended for new concrete, which is even more susceptible to salt corrosion than concrete that's thoroughly cured. Now's the time to tackle this winterizing. Pick a warm, dry day (above 50°) and sweep the concrete clean. Mix one part boiled linseed oil with two parts mineral spirits. (This is an inflammable mixture, so don't heat it, and don't smoke while you work.)

Use a brush (as shown below), a mop or a garden sprayer. Let the first coat dry 15 minutes and remove any excess oil with a cloth or squeegee. Apply a second coat and let it dry for eight hours.

Two gallons of the mixture is plenty for both coats on a double-car garage slab. It's nearly colorless—and there's a bonus: It inhibits "dusting" and makes the surface easier to keep clean.

AFTER TUNEUP—

You just had a $20 tuneup, yet the car runs worse than ever. You want to strangle somebody. Control that homicidal urge until you check the ignition system—it often masquerades as "tuneup troubles"

TOO MANY Saturday Mechanics regard the tuneup as a sort of automotive aspirin—a cure-all for a multitude of mechanical ills.

Sure, regular tuneups will prolong the life of any car's engine, but they should not be considered a substitute for particular repairs which are required from time to time. For a tuneup—like an aspirin—can serve to hide a major ailment by temporarily alleviating the "pain"—that is, by concealing the symptoms of more serious troubles.

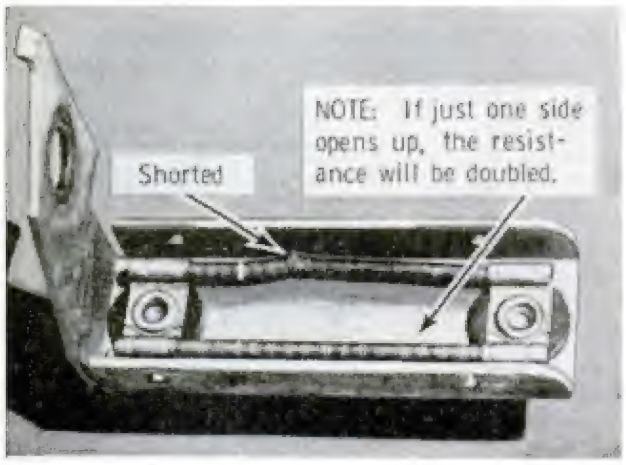
While there isn't *any* automotive problem that can't be solved, the rub comes in *finding* the problem. Many troubles that exist before a tuneup, and persist afterward, are traceable to faulty ignition. So let's examine those ignition problems which could mislead you into spending $10, $20 or even $50 for a tuneup that simply wouldn't "take."

ITEM: Fred's 1964 Pontiac was experiencing a gradual loss of power. A complete tuneup plus strict timing to specifications proved fruitless. A new set of spark plugs every 2,000 miles seemed to help for a time, but at 85 cents a plug it was getting sort of expensive. Fred was ready to toss in the sponge when I got into the act via *Auto Clinic* with a service tip from the Champion Spark Plug people (bless 'em).

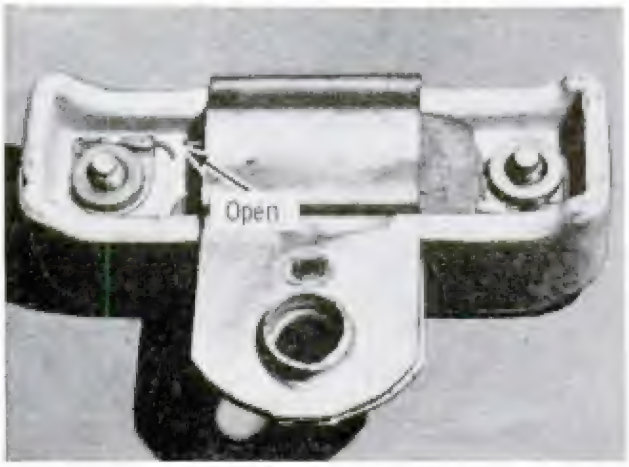
"With the introduction of the 12-volt battery as standard equipment," noted Champion, "the ballast resistor (primary circuit resistance unit) came into existence. This gadget lets approximately full battery voltage flow through the ignition coil and hence through the ignition system to the plugs during cranking to help give those 'one-rev' starts."

Fine. However, once the engine fires, the sustained high voltage would burn up the distributor breaker points if it weren't for the ballast resistor. The resistor takes the electrical load from the battery and cuts it down about 50 percent by means of a resistor wire or wires. Thus the voltage that hits the coil is about half of what the battery originally delivered.

The ballast resistor is located between the battery and the coil, usually on the



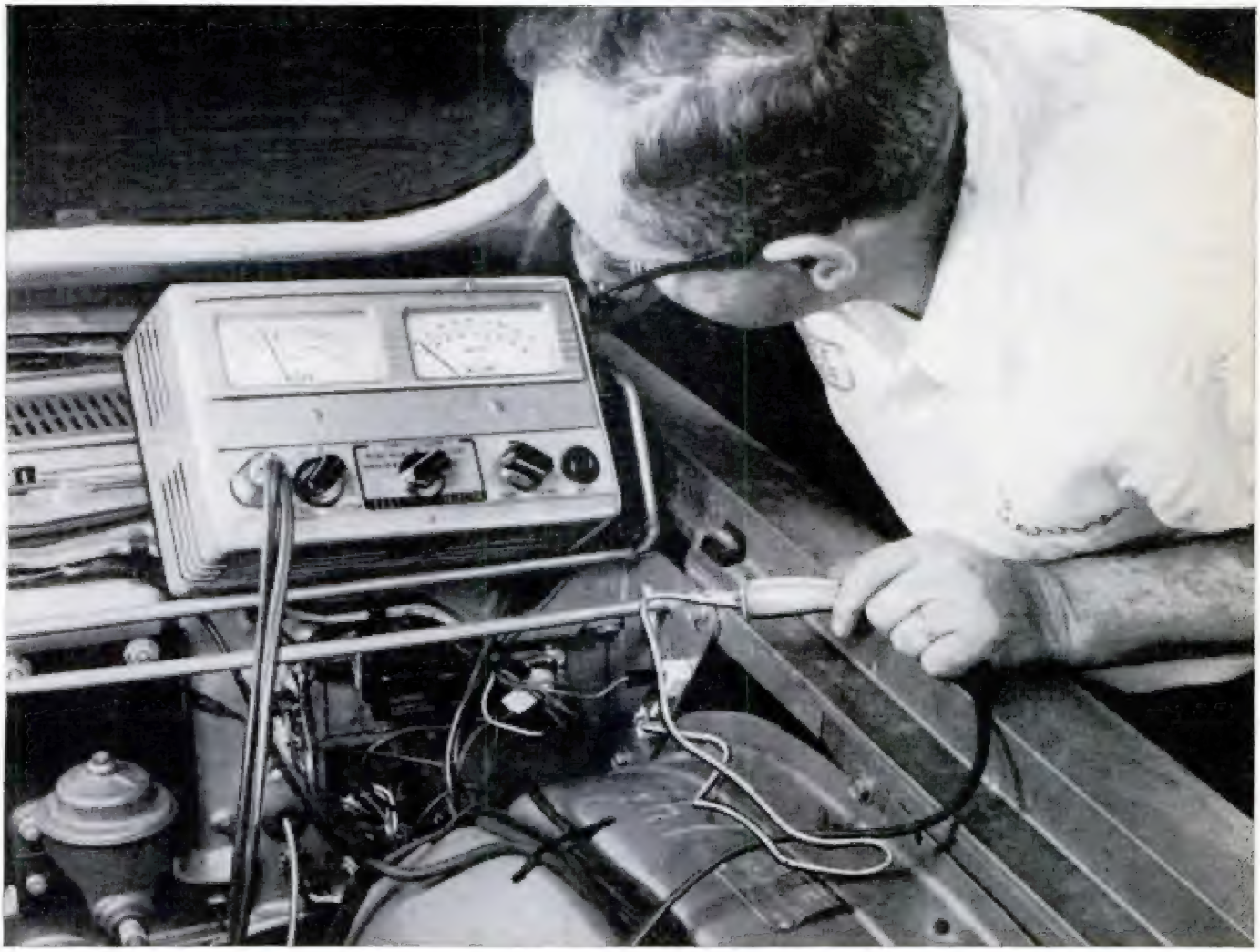
THIS BALLAST RESISTOR was put out of business when a resistance wire shorted against the case. The resistor above is a double-wire unit; other types utilize only a single wire of quite heavier gauge



ANOTHER FAILURE of ballast resistors is for a resistance wire simply to part (above). The open resistor completely cuts off electricity from the ignition system. The one cure: install a new ballast resistor

—WHAT?

By Morton J. Schultz



firewall. Having no moving parts to wear out, these are pretty dependable little items. But when one *does* go it can be tricky to troubleshoot.

A ballast resistor can fail in three ways:

(1) It can short out. If a resistor wire warps or bends and touches the side of the case, a direct short circuit of battery-voltage-to-ground is produced. This can also send a scary cloud of smoke billowing out from under the hood.

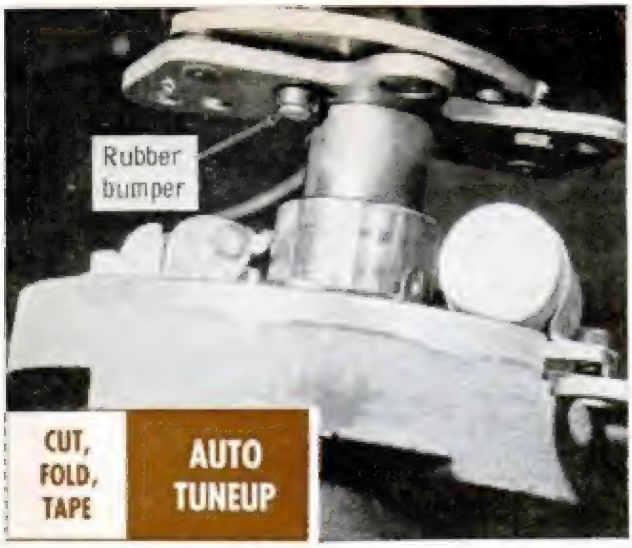
(2) It can open up. The resistance wire can part with results similar to an open switch. With the open resistor preventing current from reaching the coil, no electricity gets to the ignition system or the spark plugs, and the engine stays dead.

(3) It can change value. This is the most common failure. A change in resistance value leads to an increase in resistance so that voltage output to the spark plugs is proportionately reduced. The table on page 183 shows the relationship between increased resistance in the ballast resistor, voltage available to the coil, and the voltage which ends up at the spark plugs.

A change in resistance value takes place slowly to gradually cripple your engine's

Resistance	Volts to Resistor	Volts to Coil	Voltage Available to Spark Plugs
1.5 ohms (new)	14.6	11.1	32 KV
2.6 ohms	14.6	9.5	22 KV
3.0 ohms	14.6	9.1	20 KV
5.0 ohms	14.6	8.4	15 KV

TABLE SHOWN ABOVE relates resistance-in-ballast-resistor to volts-reaching-coil to volts-reaching-the-plugs



RUBBER BUMPER on distributor advance stop pin beneath breaker plates is designed to eliminate point rattle. Worn bumper can cause pin to drop off. Result: preignition and loss of power at high speeds

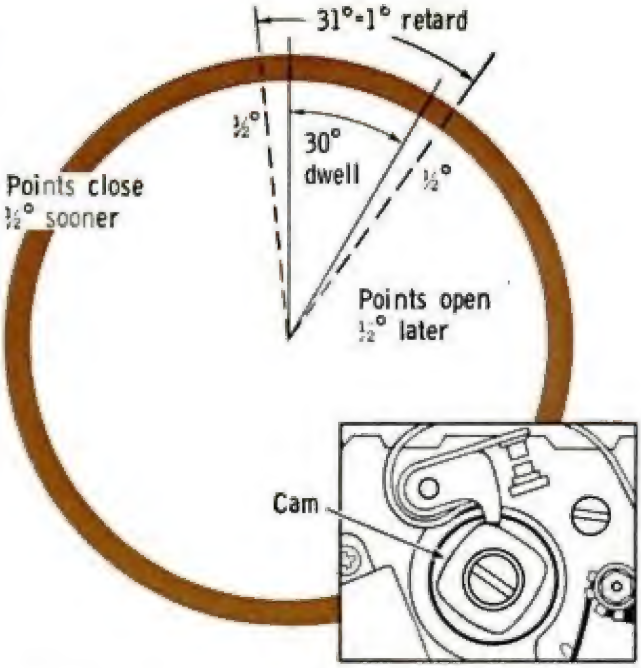
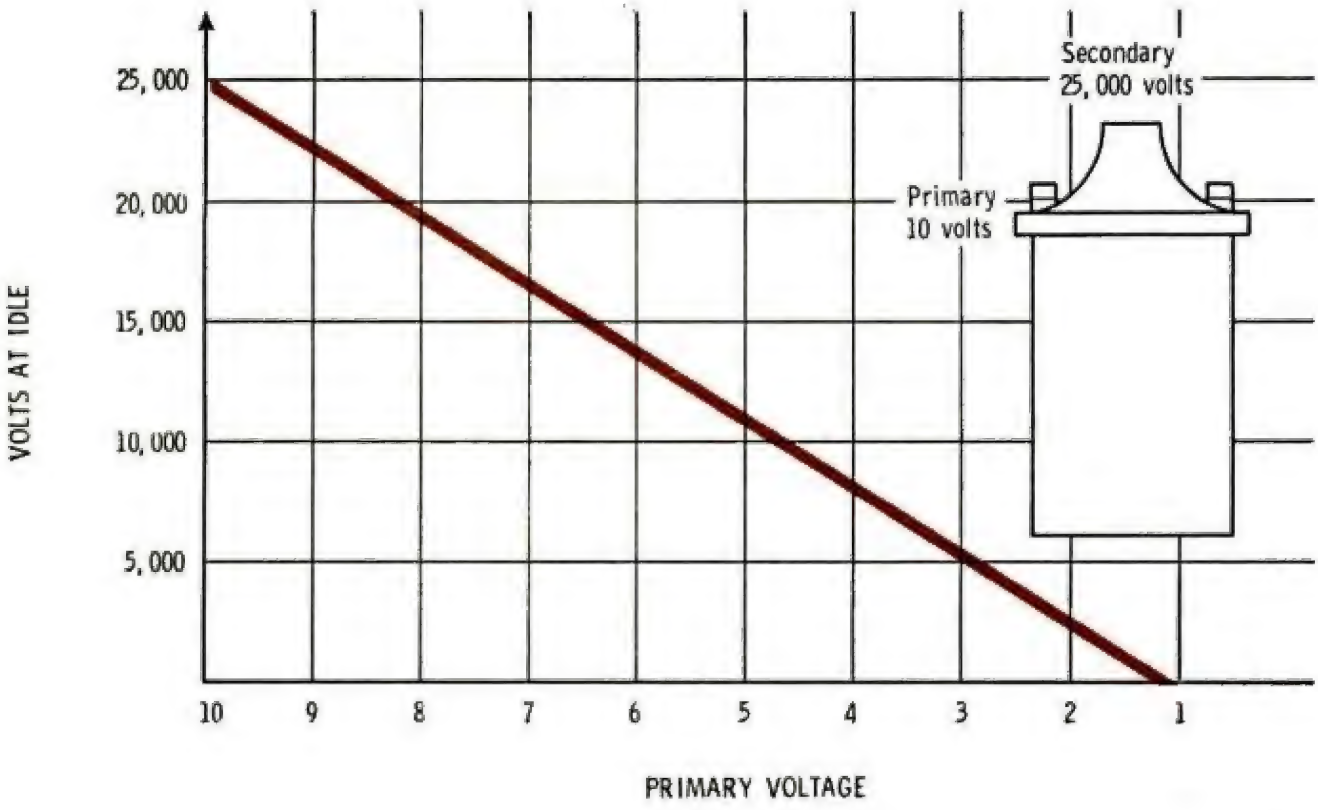


DIAGRAM ABOVE shows how a 1° increase in dwell angle causes points to close ½° sooner and open ½° later, leading to a 1° retardation of timing. A worn, poorly lubricated cam will accelerate this trouble

TO PROPERLY LUBRICATE the distributor cam, it is necessary to apply only one drop of distributor cam lubricant at one point on the cam. As the cam moves, the lubricant then distributes itself around it

GRAPH BELOW shows how 10 volts of primary current to ignition coil produce 25,000 volts in the ignition secondary. A bad connection can steal one primary volt and rob 2,500 volts from ignition secondary



power output. A tuneup won't help. Replacement of the bad resistor is the cure.

Replacing the spark plugs will mask the need for a new resistor for a time, since new plugs require less voltage to fire. But soon the car will again begin to misfire.

Connect up your trusty voltmeter, to take readings at both the input and output sides of the ballast resistor, as shown in the photo on page 183. It will show if the resistor is reducing battery voltage the required degree.

If a voltmeter is not available, it's a simple matter to replace the questionable resistor with a new one of the same type. They're not expensive and are easily installed. Then road test the car to check performance.

"Only a Volt?"

ITEM: Resistance problems were plaguing Joe's 1965 Plymouth, and his sad report went something like this:

"I turn the ignition switch and the car starts. I let go of the switch and the car stalls. I've had the fuel system inspected time and time again, but the trouble persists. What the h---'s the matter with it?"

Chrysler Corporation kindly reminded me that you can't get more out of a conductor than what's put into it. Too much resistance anywhere in the ignition system robs spark plugs of the voltage they need to fire across the electrode gap. Frayed conductors, loose connections and terminal corrosion can each or all steal a volt or two from the primary ignition circuit.

"Only a volt or two?" you ask, "That isn't much!"

Isn't it. Let's say that 10 volts of primary current to the ignition coil produce 25,000 volts in the ignition secondary at idle speed. It follows, then, that for every volt put into the coil primary you're getting *2,500 volts* at the coil secondary. So a loose connection or bad conductor that causes a loss of just one volt of primary current can very easily rob you of 2,500 volts of secondary current!

In Joe's case we suggested he check his ignition connections for corrosion and tightness. Sure enough, he discovered that the terminal that clipped to the ballast resistor on the end of the wiring harness coming from the ignition switch was covered with corrosion. Once he cleaned it he again had a smooth-running car.

ITEM: Harley's 1961 Ford began to lose power. He gave it a tuneup, even checked the ballast resistor and had it timed to specifications, but the old girl stayed sluggish. I wrote him to recheck the timing; that that might very well turn up a clue to the trouble.

This is why: there's a degree-for-degree relationship between point dwell and ignition timing. If point dwell is changed one degree, for example, ignition timing will change one degree.

Now suppose you checked the timing at tuneup time, then experienced loss of power. Upon rechecking the timing you find it retarded several degrees. What this tells you is that the guy who did the tuneup may not have checked the distributor cam. Proper lubrication of this cam should be a required part of any tuneup.

Of course, retardation of ignition timing by several degrees after 15,000 or 20,000 miles is normal, even with a well-lubed cam. But a *dry* cam will speed up this process considerably. Its lubrication requires the application of a thin film of distributor cam lubricant on the cam whenever the points are serviced. Remember too to check the timing periodically; this is vital not only for good engine performance, but can also tip you off to a cam that's running dry.

Preignition at High Speeds

ITEM: "Preignition and loss of power at high speeds is my problem," writes Mike. "Changes in gas brands haven't helped, tuneup hasn't helped, and now we're all stumped because the distributor shows an over-advance of about 2½° on the bench tester.

Doggone if the Champion folks didn't come through again with a revealing, if somewhat cryptically phrased, word of enlightenment: "Lack of bumper can be a stumper."

Their tip referred to the use of a rubber bumper on the distributor advance stop pin beneath the breaker plates of some distributors. Those bumpers are designed to eliminate possible point rattle. Sometimes wear will cause a bumper to get sloppy and drop off the pin: then the breaker plate advances a few degrees more than it's supposed to.

One type of distributor, for example, has a maximum advance of 15.5° at 2000 rpm. With the bushing missing, the advance increases to 18.8°. Some distributor breaker plates have a brass fitting instead of a rubber bumper; these serve the same purpose, but here too the pivot pin can get sloppy and the results will be the same.

This article has discussed four of the most troublesome ignition conditions you can run up against.

One final word. Don't get the impression that we dismiss the periodic tuneup as unnecessary. It's vital! But to cover all bases we suggest that you include these other spot checks in your tuneups, as well.

★★★

Auto Clinic

Mort Schultz's remedies for mechanical headaches

Rabid Ford

What causes my '58 Ford's power steering system to lose 1 to 1½ in. of fluid? The pump and the relief valve have both been checked out and appear okay. What else could be the matter? —Hector Ballentine, St. Louis, Mo.

The system probably has a case of the foaming "rabies." With a good relief valve and a leakproof system, fluid can only be lost through the vent hole in the reservoir cover. This happens when the fluid starts foaming because of a buildup of internal pressure. Stop this foaming by fashioning a leather washer to fit over the metal one you'll find beneath the cap vent hole. M.S.

Reader Reveals Repair

Your fix for a sticky Corvair gas pedal (June *Auto Clinic*) was on the beam, but I'd like to offer another in case yours might not have worked for some guys. I too tried a stronger return spring and cleaned out the dirt and gunk from beneath the pedal, all without success. Then I took the unit apart and found that both the mounting bracket beneath the pedal and the round shaft that's supposed to turn in it were rust-bound. I cleaned both and then drilled a small hole in the bracket that allows me to apply a few drops of oil every so often without having to pull the thing apart. No problem since. —Bob Clark, Madison Heights, Mich.

Thanks, Bob. By the way, we'd like to hear from some more *Auto Clinic* readers. Write us *your* solution to an automotive problem and we'll make every effort to publish it in this column. M.S.

Some Meteors Play Tag

My 1963 Mercury Meteor keeps stalling. We've gone over it from stem to stern, but with no luck. I'm writing to let you know that some problems *can't* be solved although you always seem to indicate that they can. Guess you're just an optimist.—Martin Linz, Harrisburg, Pa.

And I'm just as optimistic as ever, Martin. With this car, as with other '63 Merc models, it's been found that a cause of stalling—believe it or not—has been *the coolant instruction tag under the hood.* If this tag is in its original factory-placed position it can be sucked into the air cleaner opening. This cuts off the supply of air to the engine which, of course, causes the engine to cut out. M.S.

Coolant's Got Him Hot

The coolant leaks from an exhaust manifold stud of my 1963 Olds F-85. I haven't been able to stop it. Any suggestions?—John Klummer, Lexington, Ky.

Oldsmobile says this common problem can be stopped by removing the manifold and leaking stud and carefully cleaning off the threads. Then apply a *thin* coat of Permatex No. 1 to the threads and reinstall stud and manifold. Don't use too much sealer; the excess can build up on the manifold face and leave the manifold nuts loose when the sealer burns away. M.S.

Buick with a Bang

My 1959 Buick Electra 225 makes a clanking sound when I go over a bump —like two pieces of metal being banged together. I can also produce this noise by rocking the car from side to side. Should I have the rear pulled, or isn't it anything to worry about?—William Pallum. San Francisco, Calif.

It's tough to diagnose any noise "by mail." However, in this case I'd be inclined to say that this is probably nothing to be concerned about. These Buicks tend to develop a sort of clanking sound which is caused by the normal end play of the axles. It happens when the axles hit against the spacer blocks inside the differential carrier when the

Each month Auto Clinic answers your questions on car repair. For a personal reply, please enclose 25 cents in coin to cover mailing and handling. Address questions to Auto Clinic, Popular Mechanics, 575 Lexington Ave., New York, N.Y. 10022.

car goes over a bump. Some guys have set about eliminating this noise by reducing the space between the axles and spacer blocks. I don't advise this, though, because it puts excessive strain on the spider gears. M.S.

Volv-Whoa!

Even when it's in gear, my 1958 Volvo starts to roll slowly down hill when it's parked on a steep grade. Some day I'm going to look awfully stupid chasing this car like a Keystone Cop. The clutch isn't slipping—my mechanic says it's in good shape.—Tim Josephs, Montreal.

Hey, Tim, are you yanking the emergency when you park on those hills? And if so, what kind of shape is *it* in? Anyway, cars that have low compression ratios to begin with (such as the Volvo) do have a tendency to do this sort of thing as they get older. Your clutch probably *is* in good condition. It's likely the weight of the vehicle is just too much for the decreased holding power being provided by the decrease in compression that comes with age. You can confirm this theory by making a compression test. Chances are you'll find it below manufacturer's specs. M.S.

Microbus Won't Back

My 1957 VW Microbus has the twitches. When I shift into reverse and engage the clutch it jumps out of gear. I can't even hold it in; the gears start to grind and there's a tremendous force against my hand. Do you have a cure for this balky bus?—Ed Duff, Bristol, Conn.

Installing a new idler gear in the transmission will very likely cure this ailment. M.S.

Auto Upkeep Tips

• **SOME '65 TEMPEST SIXES** have been balking because of carburetor load-up. Pontiac engineers suggest three possible causes of this trouble: (1) Improper setting of the choke thermostat rod to manifold; (2) improper distributor point gaps; (3) the thermostat spring in the choke housing, which connects to the exhaust manifold, could be attached in the wrong direction. Check out (1) and (2). If trouble persists, replace the thermostat spring and housing.

• **THIS SENSIBLE ADVICE** is from Chevy, but all car owners would do well to bear it in mind: Never use polish on bright interior trim areas such as are found around clusters, consoles and arm rests. Much of this trim is chrome-finished plastic and will become marred when subjected to silicones or abrasive compounds. Best way to clean this stuff is with a damp cloth, followed by a buffing with a soft rag.

• **WHEN THE '65 STUDEBAKER HAWK** with disc brakes fails to brake properly, check for worn or glazed brake pads, improperly adjusted rear wheel brake shoes, low vacuum supply to the Hydrovac, and improper operation of the Hydrovac. If the brakes still fail to come up to snuff, Studebaker suggests you install their Kit No. 1565515 to the Hydrovac. It'll increase Hydrovac output pressure about 100 pounds.

OFFBEAT TRICKS WITH YOUR

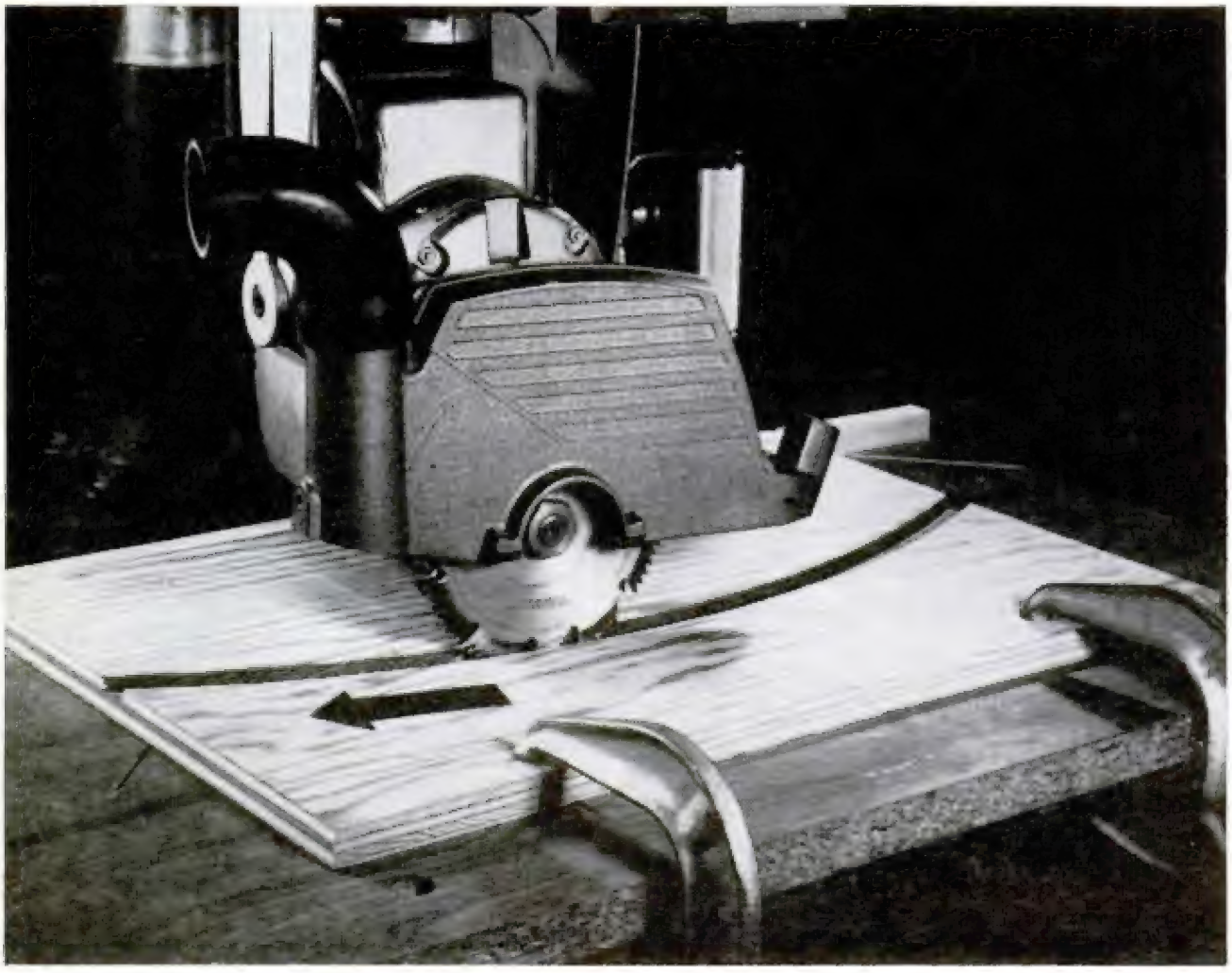
Radial-Arm Saw

By R. J. DeCristoforo

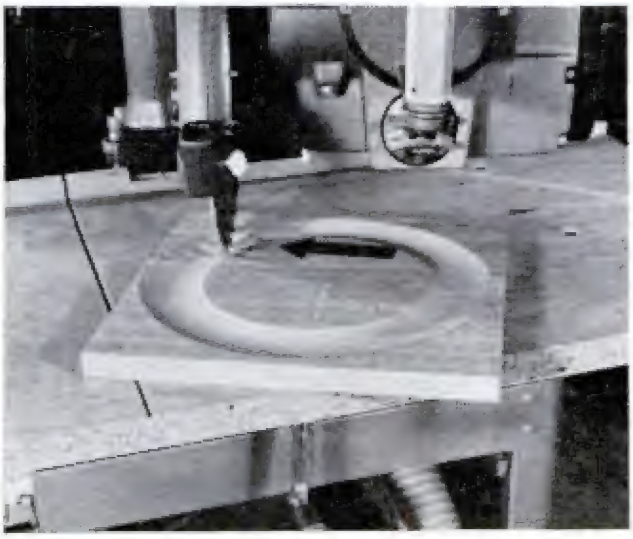
IF YOU'VE LOOKED upon the radial-arm saw as nothing more than a cut-off tool, you're in for a surprise. For, by fully utilizing its swiveling, tilting, swinging and sliding movements, you'll find yourself doing such a bagful of tricks with this versatile machine that its basic cutoff function will seem almost incidental.

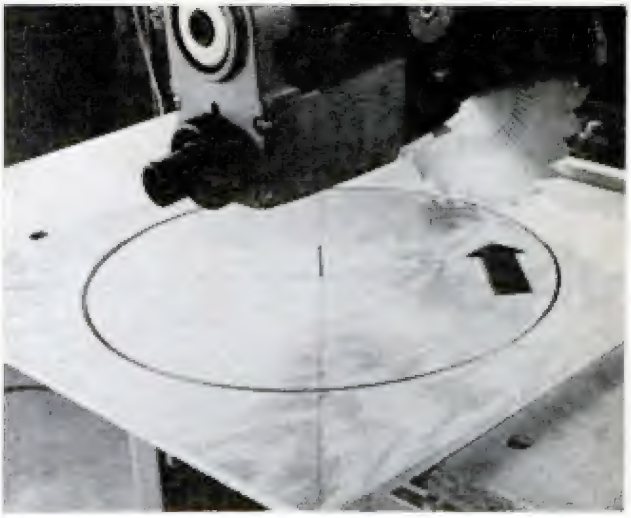
Once you master a few settings, you can use the saw for jobs you'd otherwise have to do on a lathe, jigsaw, router—or by hand. In some cases, the way the tool performs suggests special decorative treatments you could achieve by no other means. The techniques demonstrated on these pages are only a starter.

CURVED GROOVES AND SLOTS can be formed with the power unit locked in the rip position and the saw arm swung right to left. Work is clamped securely to table and dado cut is achieved by repeat passes of ⅛-in. bite



BY SETTING BLADE in rip position and using a nail as a center pivot (right), you can rotate the workpiece against blade rotation and thus cut a perfect circle. Since the blade is always tangent to the arc, you are actually making a cove cut, but as this occurs in the waste only, the edge of the circular piece is cut square. Cut should be made with repeat passes, lowering the blade about 1/16 in. each time as you cut completely through to the work surface beneath

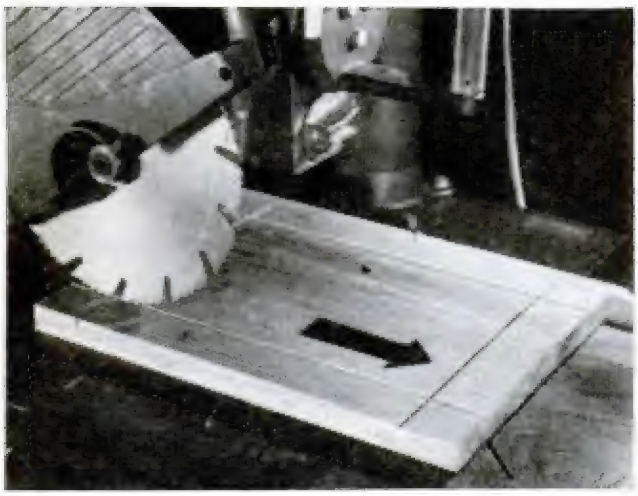




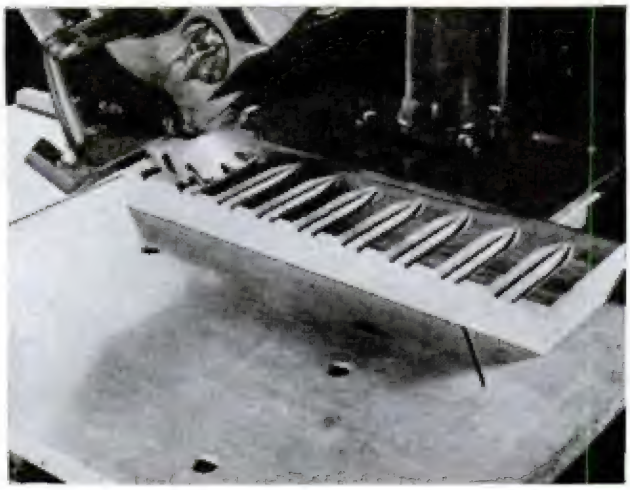
SIMILAR SETUP IS USED for cutting circular coves as for cutting circles. Main difference is that saw blade is adjusted so that it is actually cutting a true cove instead of tangent to the arc. The greater the offset of the blade in relation to the circle, the wider the cove cut. Since the blade does as much scraping as it does cutting, full depth of cut must be made by repeat passes, the final one with blade barely touching to produce the smoothest possible surface

SMALL CIRCLES can be cut in this unique manner simply because the power unit can be rotated 360°. Clamp the work securely to the table and tilt the dado about 10°. Lower the dado slowly until it makes a small bite and then rotate the power unit a full circle. Repeat the step, taking a 1/8-in. bite each time until the cut is complete. If you plain to cut completely through, back up the work with a scrap piece to avoid cutting into the saw's wooden table

SAUCER CUTS (below) are accomplished by swinging blade back and forth through power units tilt range in the crosscut position. Full depth of saucer shape is achieved by making repeat passes, and you can cut faster and deeper if you do the job with a dado as shown. Be sure the workpiece is clamped securely and keep the hands well away from the cutting area. Saw's tilt stop must be disengaged, of course, to permit unrestricted swing of power unit

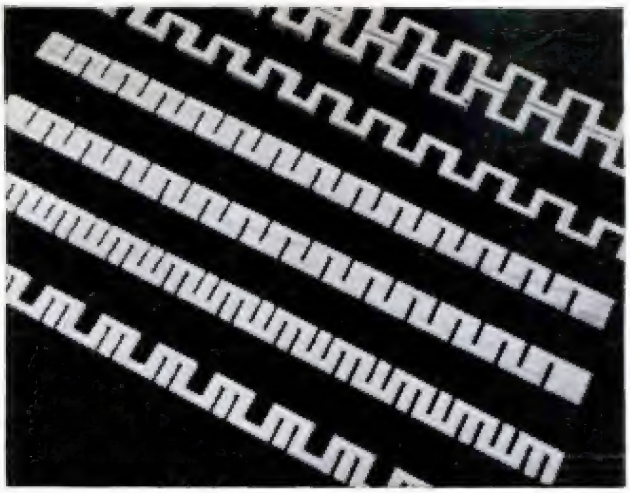


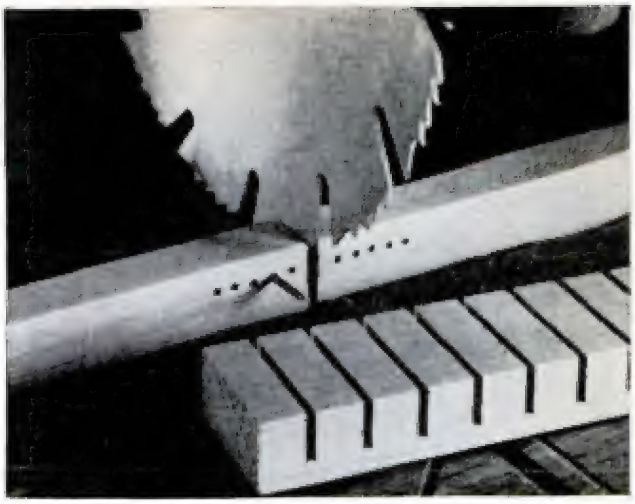
PANEL RAISING can be done in a more convenient manner on a radial saw than on a conventional table saw since the operation is done with the workpiece flat on the table. With the power unit set in the *rip* position and at the desired distance from the fence, ⅛-in.-deep shoulder cuts are made in the surface of the panel first, running saw cuts around the four sides. Then to "raise" the panel, the power unit is set for horizontal cutting, the saw tilted up a few degrees and the panel is fed past the slanting blade as it is guided along the fence. The blade height must be set so the cut ends at the very bottom of the kerfs. Since the blade must clear the saw's fence, it is necessary to support the work on an auxiliary panel of the proper thickness, to raise it above the fence. The panel is temporarily fastened to the saw's table



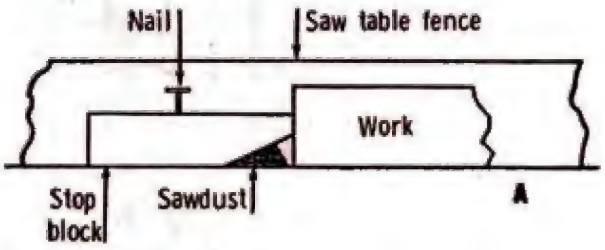
LIMITLESS VARIETY of fancy decorative cuts is possible through the saw's tilting action. The faceted surface you see here is accomplished with a dado by setting the power unit in the rip position and then tilting it 45°. Each pass produces a V-groove, so equally spaced cuts, with and across the grain, create a pleasing decorative surface. Smooth job results when the crossgrain Vs are made first; this holds true in making any cuts both with and across the grain

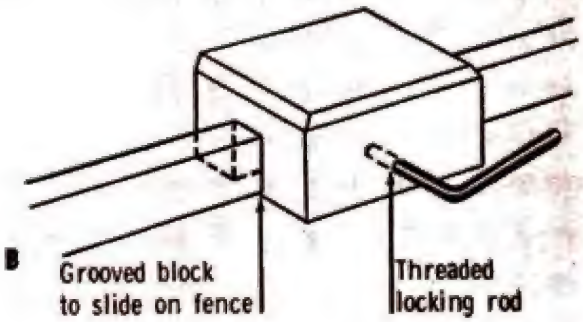
IN ANOTHER EXAMPLE of decorative "carving," the power unit is set in the crosscut position and tilted 45°. To form one side of the gothic V-cuts you *pull* the dado. To cut the other, you turn the work end for end and *push* the dado across the work. A C-clamp attached to the saw's arm serves as a stop to limit travel of power unit and establish length of grooves. Spacing of each pair of cuts is assured by use of a stop block which is repositioned as work is shifted



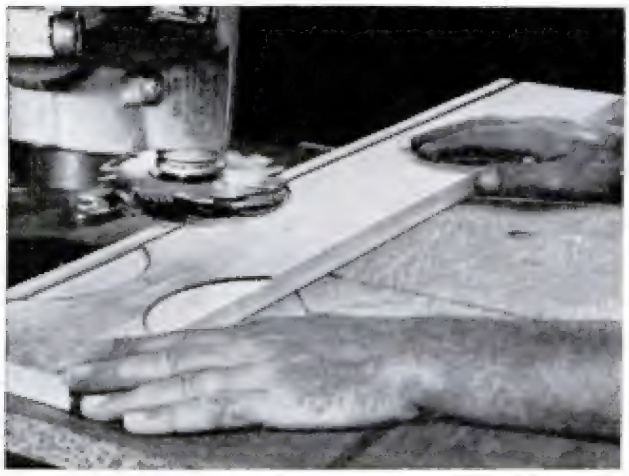


EXAMPLES OF "DENTIL" TYPE MOLDING which are formed by kerfing as shown above, left. Some are made with a saw blade, others with a dado blade, still others by combining both. Cuts are made across grain of thick stock, then sliced lengthwise into thin strips. Top molding in photo results in joining two pieces edgewise. An endless variety of patterns is possible by varying spacing of cuts

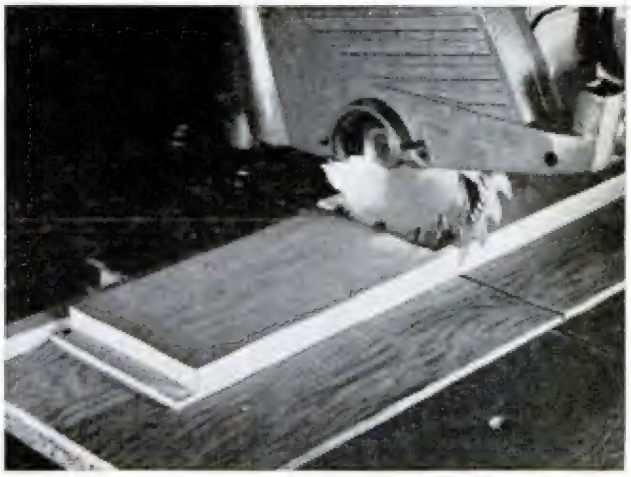




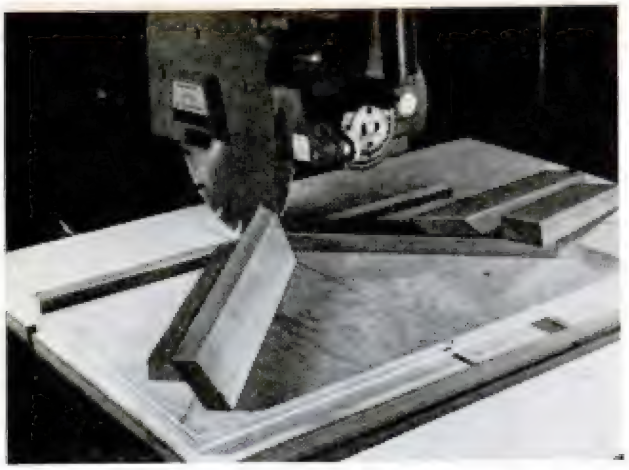
WHEN A STOP BLOCK IS TACKED TO THE TABLE, sawdust can't build up and interfere with the workpiece if you bevel the butting end as in detail (A). Detail (B) shows how you can make a handy adjustable stop block that rides and clamps to the fence

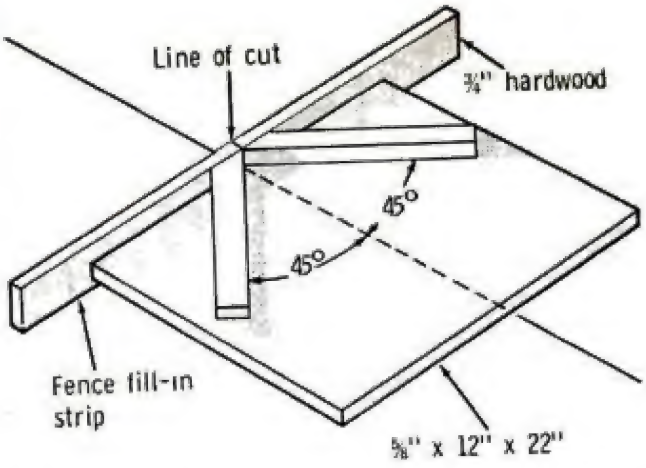


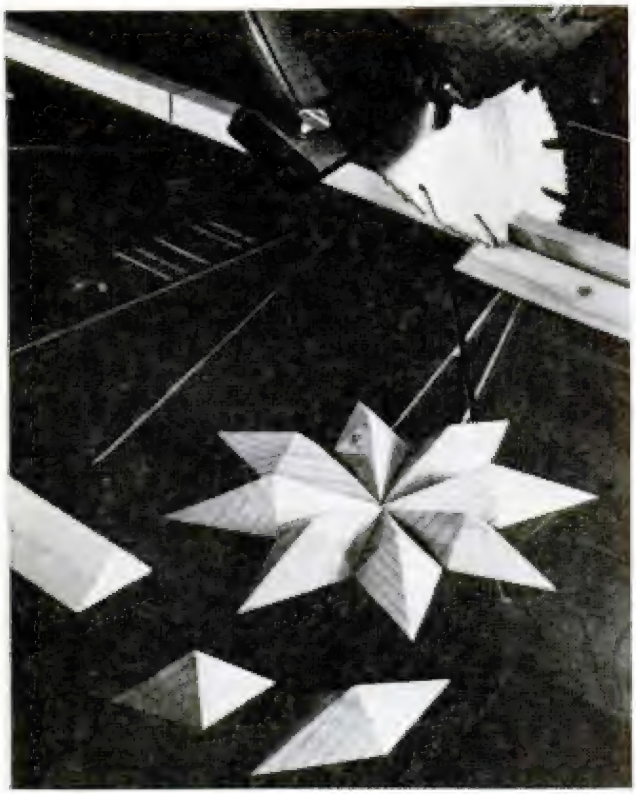
TO FORM SCALLOPS with a dado, set the power unit in a horizontal cutting position and lower it so the dado just clears the fence. Feed the work slowly since the dado will tend to kick the work out of position. A C-clamp attached to the saw's fence will provide a stop against which you can brace the workpiece as you feed it. This basic cut can lead to many pleasing designs merely by changing the spacing between the units. Saw guard has been purposely removed to show operation more clearly in this photograph, but for actual cutting it should always be in place as a dado in this position can be quite dangerous



YOU CAN PERFORM DUAL OPERATIONS that save considerable time by combining different blades on the saw's arbor. Here a 6-in. dado and a 7-in. saw blade ganged together not only severs the workpiece but forms an end rabbet both at one pass. Likewise, two saw blades of equal diameter spaced apart with washers, will cut kerfing time in half. Surface kerfing with twin blades spaced apart will also add a decorative border to wall plaques, drawer fronts, etc. When end-rabbetting with ganged blades in the manner pictured above, you can protect the saw's table with a scrap of ¼-in. plywood.



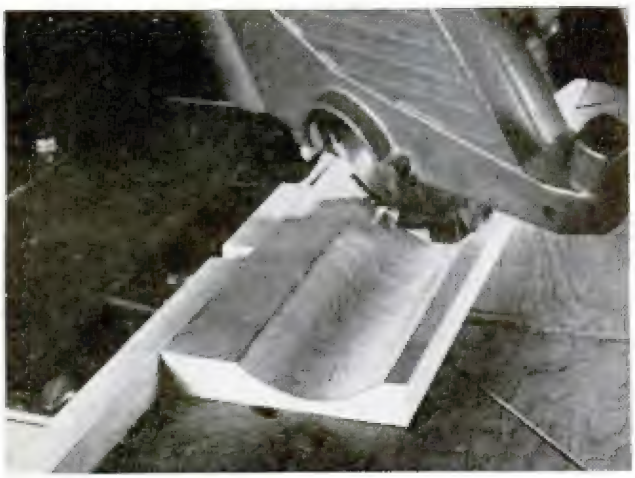




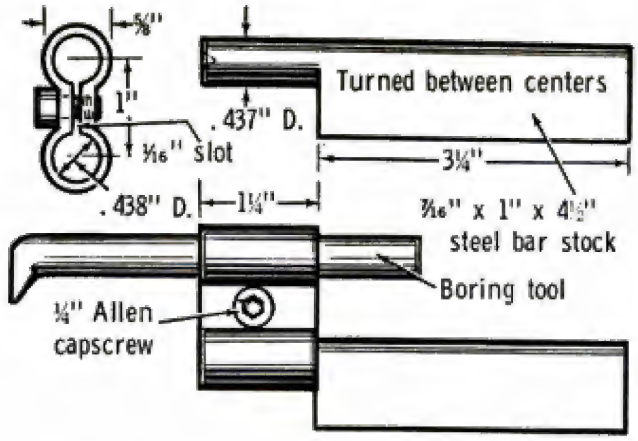
BEST WAY TO CUT MITERS is to use a mitering jig and forget the 45° setting of the power unit. The jig (detailed above) fits the slot of the saw's regular fence and is aligned with the blade so the line of cut splits it down the middle. It's the only practical way, too, to cut compound miters. Edges of stock are pre-beveled and then workpiece is stood on edge and held firmly against fences of guide as work is cut

EIGHT-POINTED DIAMOND STAR (left) is an example of the different decorative rosettes which can be assembled of pieces cut from triangular strips. Here the saw's arm is swung to a 45° setting and the power unit is tilted to match the bevel of the strips. Segments are "chopped" off in quantity by making the first cut with the stock placed to the left of the blade, then shifting it to the right-hand side to make the second cut. In each case, the blade must be in exact line with the topmost point of the first cut

DIFFERING FROM TABLE-SAW technique, cove cutting here is done from the top side of the workpiece and fed to tool along saw's fence. Either a blade or dado may be used. For the widest cove the saw is set for simple crosscutting and the blade tilted 10° to the left. Then it's located over the center of the work, adjusted to take a ⅛-in. cut and locked. The workpiece is fed repeatedly from right to left as if being ripped. Width of cove is varied by changing angle of blade, the greater the angle, the narrower the cove. Edge coves are made by varying blade angle and tilt



Adjustable Boring-Tool Holder

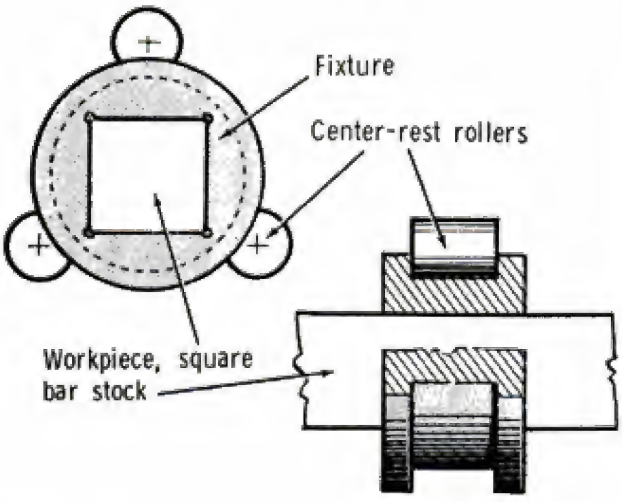


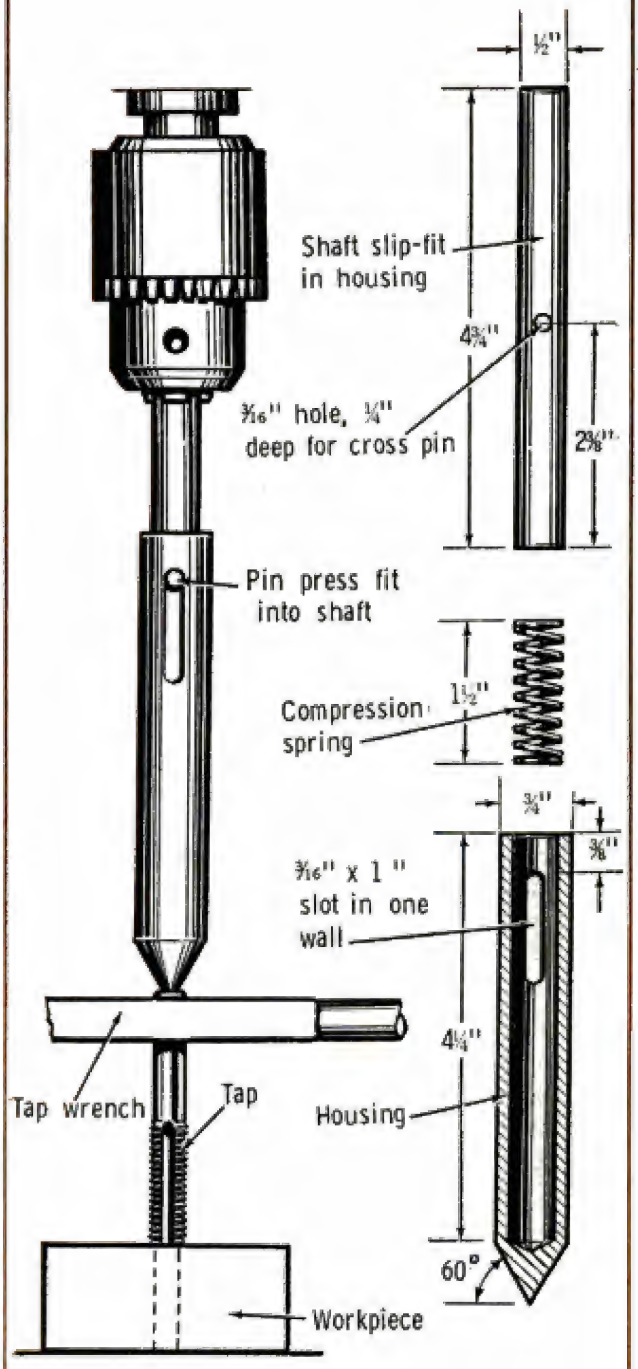
This holder with its swinging head permits universal adjustment of the boring bar without shifting it in the toolpost. A locking screw clamps the head to both bar and tool. Turn down one end of a piece of 7/16x1x4½-in. c.r. steel to .437-in. dia., 1¼ in. long and chamfer the end. The head is ⅝-in.-wide tool steel through which two .438-in.-dia. holes are drilled, then bridged by a hacksawed slot. The holes for the locking screw are drilled for a ¼-20 tap. Use a hex-head locking screw (cap screw) which can be tightened with an Allen wrench.

Turning Square Work

This fixture is designed to facilitate turning a number of long, square pieces of stock having the same sectional dimensions, and which cannot be supported by a steady-rest. A square opening just large enough to fit over the stock is cut dead center in a round turning as shown below. This piece is then retained in a conventional steady-rest clamped to the lathe bed. Note the two shoulders in which the rollers of the steady-rest ride.

—D. F. Kimberling



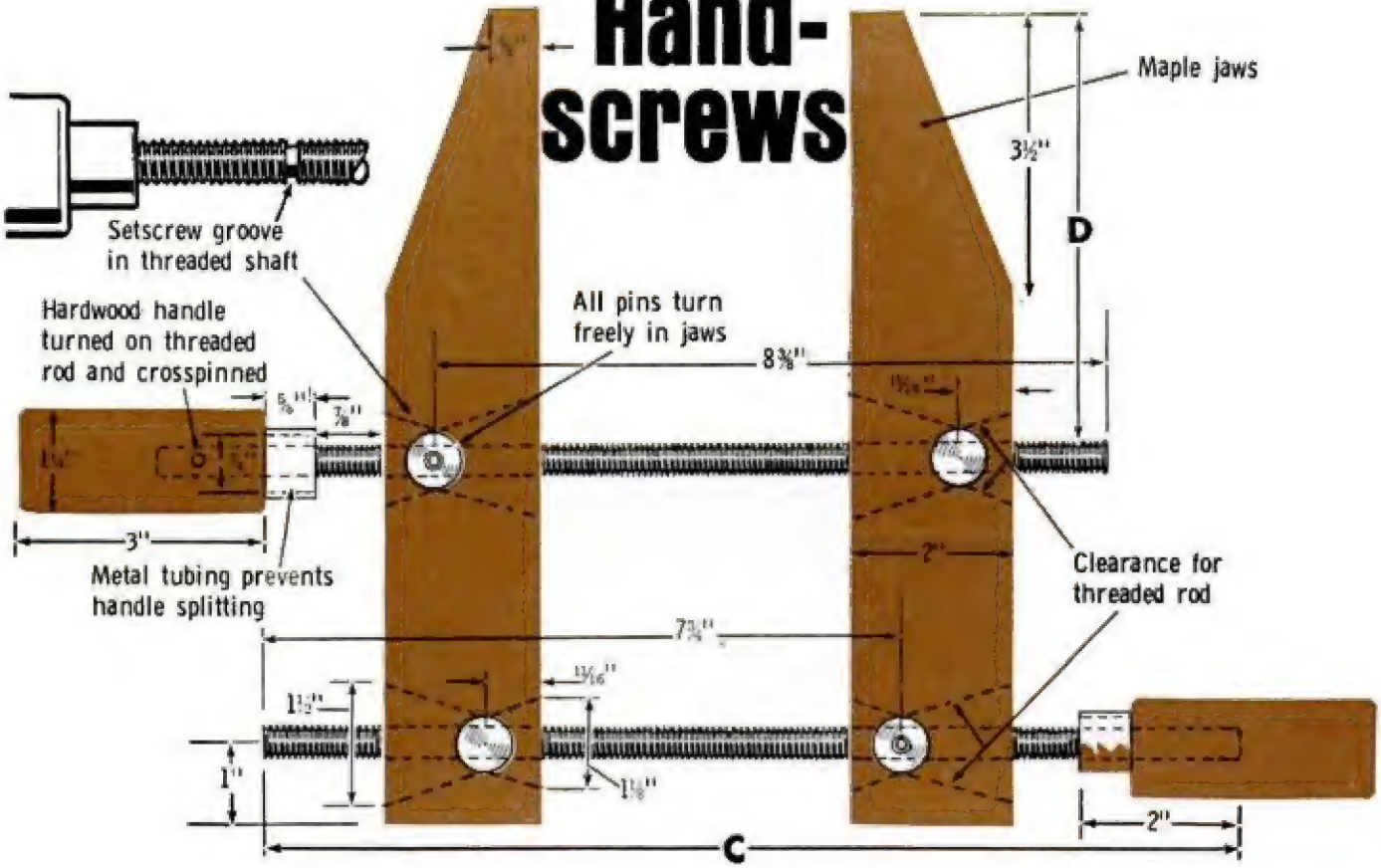


Spring-Loaded Tapping Center

You'll have fewer broken taps with this gadget chucked in either your lathe or drill press. Chuck the tap in a tap wrench in the usual way and snug it against the hole to be tapped. Bring the tapping center to bear and center on the tap until the crosspin hits the bottom of the slot. Lock the drill-press quill, and then turn the tap by its wrench until about halfway into the hole. Then back off the center and finish tapping.

—Louis Owen

Make Your Own Hand-screws



TOO MANY home shops make do with a few metal C-clamps because quality handscrews are more costly. They're worth it, of course, since they're more versatile than any standard clamp, and can do jobs that would require elaborate jigs if other types of clamps were used. The great adjustability of handscrews have kept them the first choice of fine cabinet-makers for generations.

Still, budgets are budgets, and if yours is limited, you can *make* yourself a selection of handscrews in various sizes. We give dimensions for 10- and 14-in. clamps, and with a little figuring you can adapt the plans to 6- and 8-in. sizes.

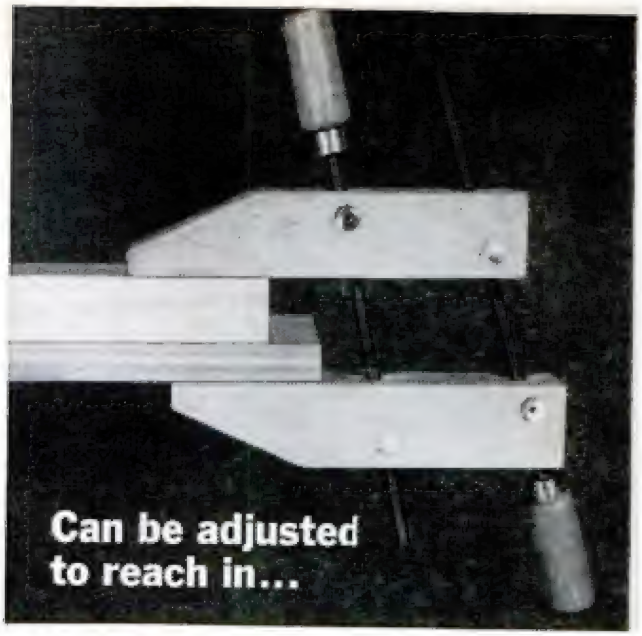
Maple or birch hardwood is best for the jaws. After cutting these to size and shape, drill the crosspin holes through the faces and the rod holes through the edges. The former should provide a slip fit for the smooth pins; the latter holes must then be tapered into butterfly slots (with a rat-tail file) as shown in dotted lines, above).

After cutting the setscrew grooves in the rods, it's a good idea to heat-treat these areas so the setscrew won't wear the groove for too loose a fit. Turn the handles onto the short end of each rod and then secure them with a pin driven into a hole you've drilled through both handle and rod. If you make your own handles, turn the familiar shoulder on the drilled end, to take a split-proofing ferrule (cut from tubing) as indicated.

Set the pins into the jaws, slide the rods through the untapped pins and turn them into the tapped ones; then line up the grooves with the setscrews and turn the latter in. Rub oil into the jaws so they won't stick to work being glued.

—Emil P. Kushner Sr.

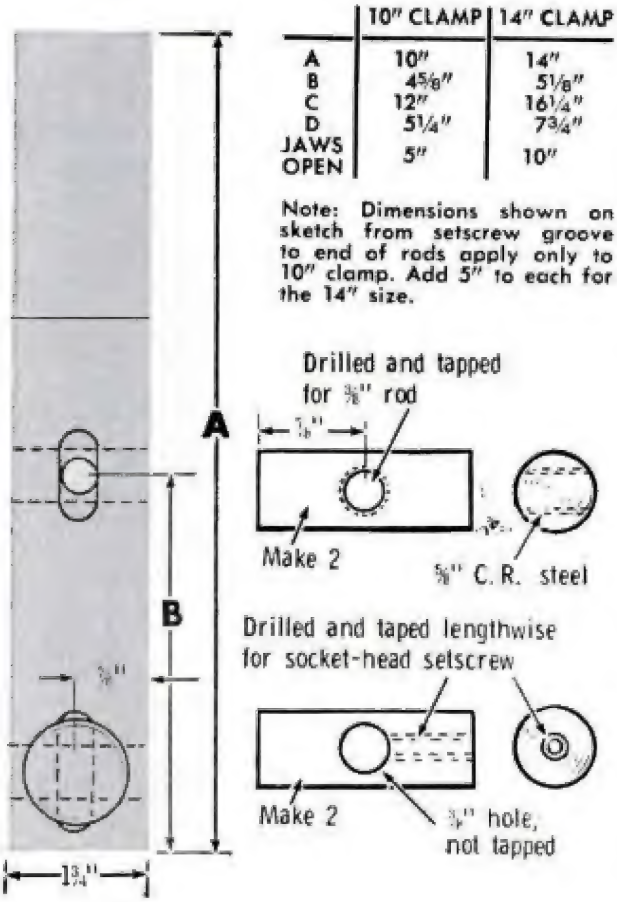
Now you can own all the quality clamps you need in your shop— you just make them yourself!

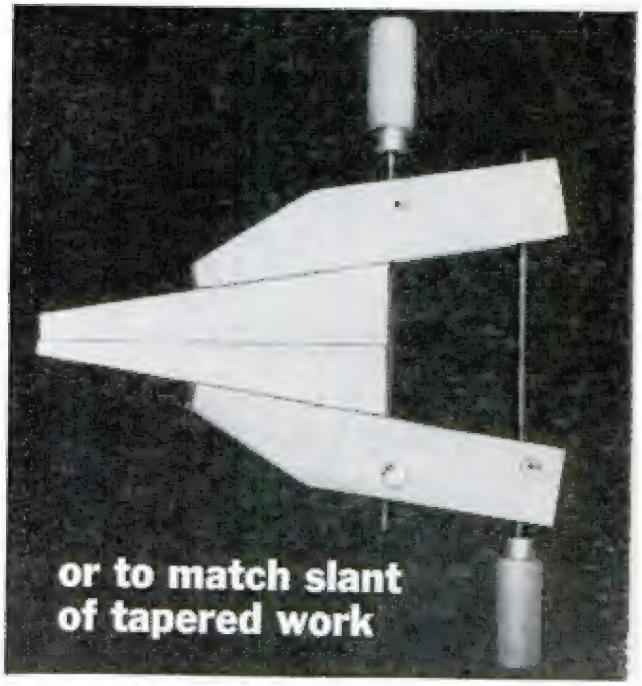


KEYED DIMENSIONS

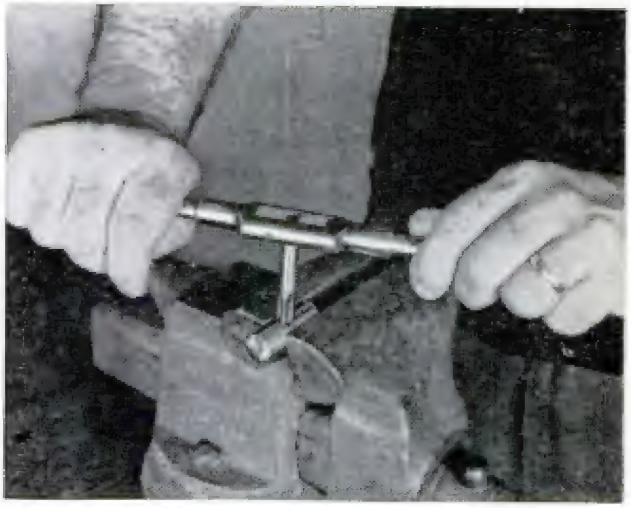
	10" CLAMP	14" CLAMP
A	10"	14"
B	4⅝"	5⅛"
C	12"	16¼"
D	5¼"	7¾"
JAWS OPEN	5"	10"

Note: Dimensions shown on sketch from setscrew groove to end of rods apply only to 10" clamp. Add 5" to each for the 14" size.





TRUE HOLES are assured if you bore the jaws on a drillpress to take the 1¾-in.-long inserts cut from cold-rolled steel. Bore on into scrap underneath



TWO PINS in each pair of jaws are tapped for the ⅜-in. threaded rod, as shown. The two others are only drilled for the rod, but tapped for setscrews

Lazy-Susan Tie Rack

AFTER SAWING, a 60° chamfer is formed on bottom edge of disc by rotating it against a belt sander

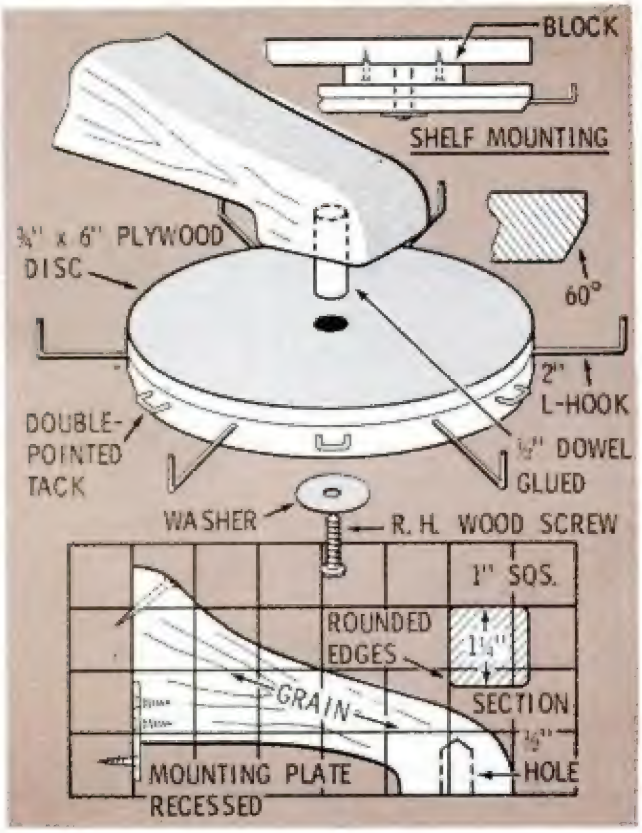
ACCURATE DRILLING of holes for L-hooks is done by using the piece from which disc was sawed as a jig

SMALL ENOUGH to fit into a corner, this compact rack spins for easy selection of both conventional and pre-knotted ties. The former are merely draped over L-hooks, while the collar clips of the pre-knotted kind hook over staples driven only part way in.

A scrap of ¾-in. hardwood plywood and a piece of 1¼-in. solid stock are needed for a wall-mounted rack. After cutting a 6-in. disc from the plywood, bore a ½-in. hole in the center and chamfer the bottom edge as shown at left. It's best to finish the disc before mounting the hardware, using either shellac or oil stain.

With a compass or dividers, mark off 12 spaces around the edge of the disc, then drill pilot holes at every other location for 2-in. L-hooks. Before screwing them in, drive in the staples so they project 3/16 in.

For mounting under a closet shelf, a spacer block is needed. For wall mounting, cut out a bracket after first boring the hole for the dowel axle at precisely 90° to what will be the bottom edge. A shallow rabbet is cut in the vertical edge to accept a small brass mounting plate.—*Hank Hilton*



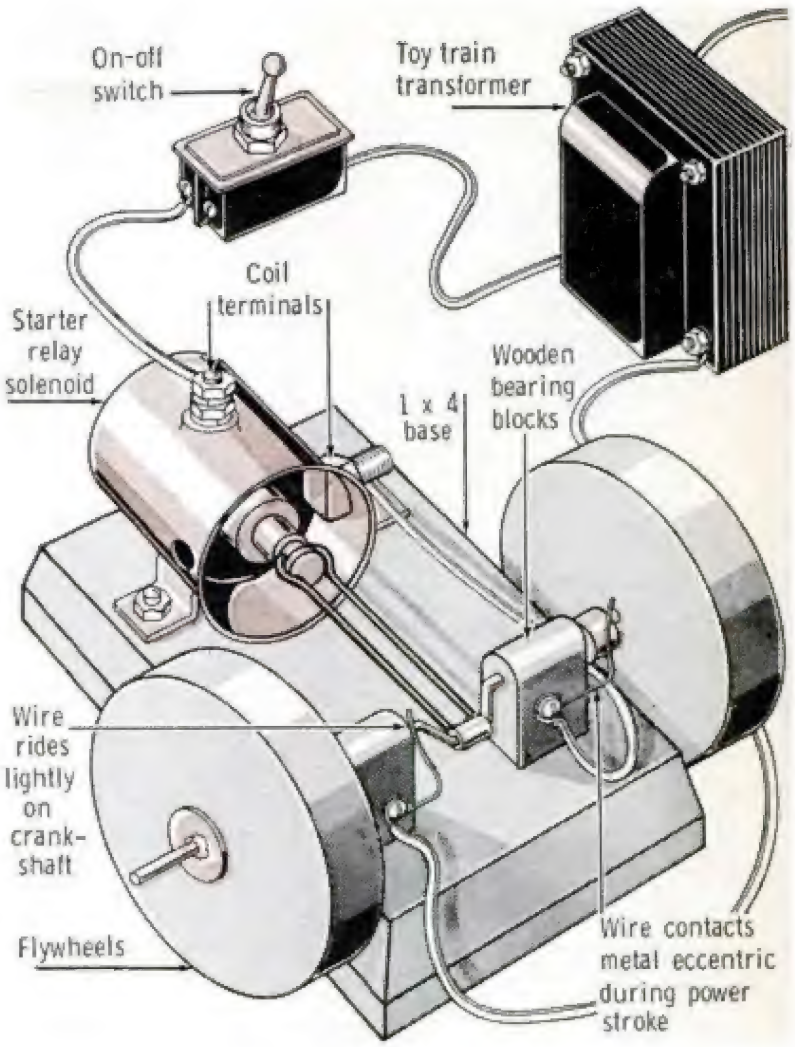
Solenoid Toy Engine Will Fascinate the PM Boy

IT WON'T DEVELOP more than 0.01 fp (flea power) but a boy will have great fun building this fascinating solenoid engine and still more fun tuning it to run like a real powerhouse.

The solenoid is a junked relay from a 6 or 12-V. Ford auto-starter circuit. Take off the front cover and remove the switch gear that's attached to the plunger. Then drill a ⅛-in. hole through the plunger shaft to serve as a wrist-pin bearing.

The connecting rod and crankshaft are formed from a wire coathanger. The crankshaft is bent so it has about ¼-in. throw. The bearing for the connecting rod is a ¼-in. length of steel tubing having an inside diameter that will just slip over the crankshaft. The tubing is slipped in place before the crank is bent and is finally soldered to the end of the connecting rod. The crankshaft bearings are wooden blocks, drilled for a loose fit, and fastened to a wooden base. The 3-in. wooden flywheels are

(Please turn to page 209)



Next Month in Shop and Crafts

GET READY FOR CHRISTMAS. If you like to make gifts for the family and to decorate your home for the holidays, you'll want to catch the big 29-page Christmas section in the December PM. You'll find a choice of three novel dollhouses, action toys, table decorations, plus prize-winning animated yard displays to put your home in a gay holiday spirit

STAIR BUILDING SIMPLIFIED. Like building a lift bridge so it will meet in the center, how do you layout stairs so you'll wind up with the proper rise and headroom? It's perplexing sometimes for even the experienced carpenter, but it's all figured out for the home remodeler in a handy chart included in a short-course in stair building in December PM

BANDSAW SPEED REDUCER. Gearing down your bandsaw so it can cut metal as well as wood, makes it twice as useful. An auxiliary switch-over unit having its own motor, reduces the normal wood-cutting speed so you can cut ⅛-in. steel and even thicker medal. You convert by simply engaging a drive pin in the pulley shaft or a worm gear attachment driven by the second motor. Learn how to build and install the unit on your saw in the December issue

don't let electrical problems STOP your car

By Brice Ward

THIS CAR'S REGULATOR IS GOOD. Meter is connected to B terminal and to lead previously removed from this terminal. Normal reading is 30 amps.

Build this $14.95 A-B-G-R kit to find and fix auto electrical troubles quickly. Check alternator, battery, generator, regulator.

HAVE YOU EVER WISHED you could make a quick check of the condition of your battery? Car battery, that is . . . because maybe it doesn't start the engine in the morning the way it should? Perhaps the starter runs a little slow or the spark just isn't up to par? Does the regulator leave something to be desired?

The little instrument described here will do about anything in the electrical circuit of the old bus except, perhaps, check the secondary circuit of the ignition system. Because of its extreme versatility, we call it the A-B-G-R tester, which stands for alternator, battery, generator and regulator tester. It will also check for grounds and open circuits by using the automobile electrical system for an assist.

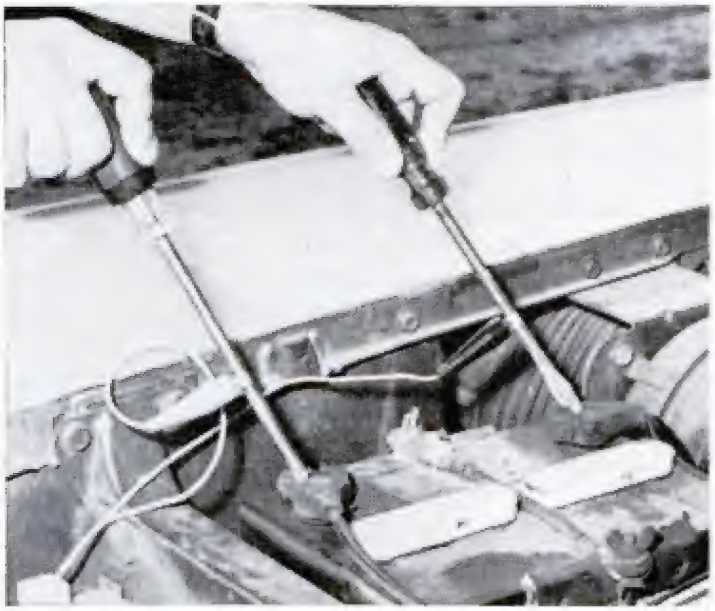
Let's look at its functions first. It can measure voltage on either an 8 or 16-v. scale (corresponding to 6 and 12-v. systems). It can check regulator operation. It can be used to measure current to 60 amps., which is ample for almost any ordinary make of car, even when it may happen to be equipped with an alternator.

As a bonus, it features a separate 3-v. scale for checking battery cell voltages and for troubleshooting by the voltage drop method. The ammeter can also be used to check the current drawn by lights, the ignition system and other accessories.

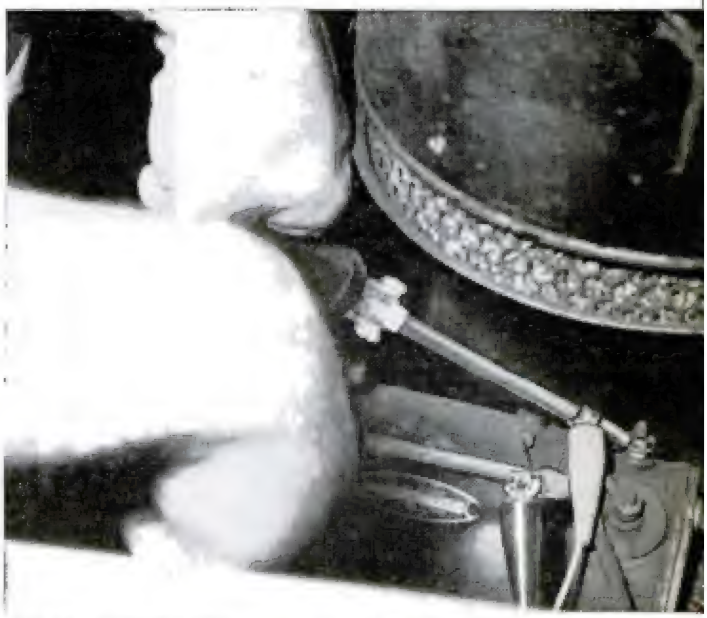
The entire unit can be slipped in the glove compartment of most cars and will save many hours of looking for simple troubles as well as many dollars in repair bills if properly used.

You can build the A-B-G-R from scratch or buy a complete kit of parts from Techni-Kits for $14.95. It is a complementary unit to the cam-dwell meter (page 196, Feb. '64 *PM*), another Techni-Kit available for the same price. Full details are given in the parts list.

To build your A-B-G-R, make and drill the panel first. The kit panel is supplied punched and drilled, but if you are making your own, a simple ⅜-inch round hole is easiest to make for the slide switches. A 1¼-in. round hole takes the



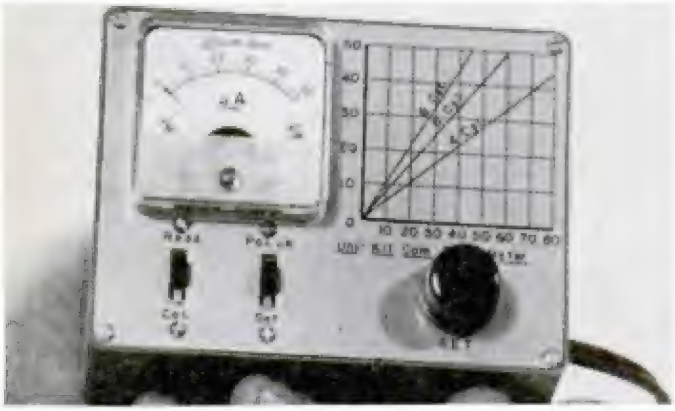
QUICK-CHECK BATTERY CONDITION by measuring battery voltage. Connect probes across battery posts. Good batteries read higher than 6 or 12-v. ratings



GOOD GENERATOR puts out about 7 v. if in a 6-v. electrical system, or 14 v. if in a 12-v. system. Take A-B-G-R reading right off generator terminals

CONVENIENT METER PROBES are actually a pair of ordinary screwdrivers. Clip A-B-G-R test leads to screwdrivers and you're in business. Excellent to check battery and generator

CAM-DWELL METER is companion to the A-B-G-R tester. Use A-B-G-R to check the car's electrical system first, then cam-dwell meter to tune up the engine for full-power operation



PARTS LIST

#1—58,000 ohms, ½-watt, 1% resistor
#2—3,900 ohms, ½-watt, 1% resistor
#3—159,000 ohms, ½-watt, 1% resistor
S1—d.p.d.t. slide switch
S2—s.p.d.t. slide switch
J1, J2—banana jacks (red, black)
Meter—1-milliampere movement
Alligator clips (4)
Alligator clip sleeves (2 red, 2 black)
1½-in. No. 18 tinned bus wire
Bakelite case to suit (3x4x5 in.)

All parts for A-B-G-R tester can be ordered from most mail-order electronic houses. For list of firms, address Electronics Editor, Popular Mechanics, 575 Lexington Ave., New York, N.Y. 10022.

Complete A-B-G-R kit can be ordered from Techni-Kits, 250 Broadway, New York, N.Y. 10013. Price of $14.95 includes case, pre-punched and printed panel, all electronic parts.

meter and the banana jacks require ¼-in. holes.

Drill two small holes—¼-in. will do—for the volts and amps. leads through the side of the case. Follow the pictorial diagram for all wiring. Since the switch tab holes are rather small, you may have trouble connecting the lamp cord to them. The remedy is to cut the insulation back about ⅛-in. Tightly twist the small bit of wire extending beyond the insulation and force it through the hole. All of the wire will not go through and some strands will fan out around the switch tabs or lugs. Carefully solder the connection allowing the solder to fill neatly around the fanned-out portions. The result will be a neat, solid connection.

The ammeter is a special design that keeps the length of wire through which the high current must flow to a minimum. It allows the use of low-current-capacity switches.

The current flows through the black test lead to the shunt and the proportional current goes onto the meter by way of the amps-volts switch.

In theory, 60 amps flowing through the shunt will cause a voltage drop of 40 millivolts and full-scale meter deflection. Although the accuracy does not approach that of a 1 percent precision system, it is more than adequate for the measurements required.

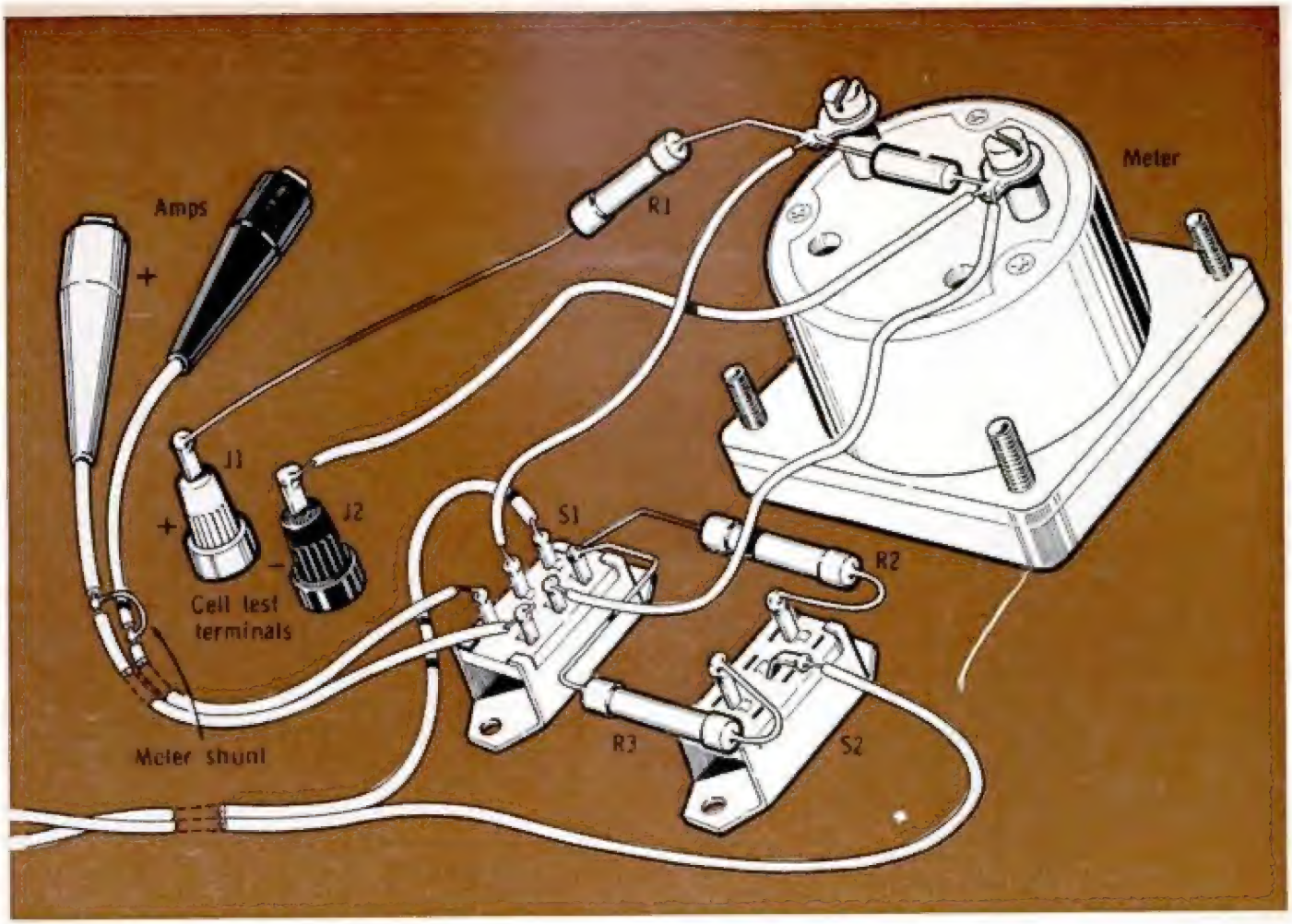
To make the shunt, slip a red boot over the ammeter cable. Cut the positive lead of this cable 1⅛ in. shorter than the other. Strip both leads and take the piece of No. 18 bus wire (which should be a little longer than the 1⅛ in. required) and lay it next to the longer lead of the lamp cord. Bend the stripped end of the lamp cord 90° and wrap it around the bus wire. Then solder securely. Now do the same thing at the other end. Be sure that the distance is precisely 1⅛ in. Next add the clip connectors.

If a *very* small amount of solder flows onto the critical length, there is no problem, but a blob of solder or an amount that increases the diameter of the bus wire considerably or covers ⅛-in. or more of the wire shunt will cause some inaccuracy.

There are many uses to which this instrument can be put. Here are the important ones:

The Cranking Circuit. Connect the voltmeter section of the tester between ground and the B terminal of the regulator. The indicator should be in the *yellow* area to show that the battery is good.

Now disconnect and ground the secondary or tower terminal of the coil to insure



that the engine does not start and crank the engine while observing the meter. The reading should not drop below the *red* zone. If it does, one of three things may be wrong.

- The battery may be low.
- The battery connections may be bad.
- The starter may be drawing excess current.

To check the first, measure the voltage from one lead terminal to the other while cranking the engine. If the reading is the same as the one obtained at the B terminal of the regulator, the battery is bad. If the reading is higher, shift to the 3-v. cell test portion of the meter. Measure the voltage from the ground post of the battery to ground while cranking the engine. If a voltage appears here, clean the connection to reduce the resistance.

In a similar manner, check the voltage from the "hot" battery terminal to the cable connector. Clean the post and connector if the voltage is high here.

If the voltage is still low at the B terminal of the regulator, the starter is drawing too much current.

If the cranking circuit is good, disconnect the regulator B terminal and connect the ammeter clip leads. One lead is connected to the B terminal of the regulator, the other to the lead just removed. Now reconnect the coil high tension lead and start the engine. If the meter deflects in the wrong direction, stop the engine and reverse the leads. No damage will be done to the meter when checking polarity in this way as long as the engine is not raced. Connect the red voltmeter lead to the B terminal of the regulator (negative ground systems) and the black lead to a good ground.

With the engine running and warmed up, (about 15 minutes) put the volts-amps. switch in the volts position and accelerate the engine to 2000 rpm. The meter should read about midway in the green section.

Switch to amps. and again accelerate the engine to 2000 rpm. The ammeter should rise to the current setting of the regulator (30 amps. in most normal service systems), then stop. If it goes beyond the manufacturer's specifications, the regulator is bad and should be replaced. Also, if the voltage goes above the green band by any great amount, or does not come up to the green band, the regulator should be replaced.

There are dozens of other tests that can be made with this instrument. Almost any test that can be performed with a commercial voltmeter-ammeter can be performed equally well with this instrument. ★ ★ ★

new in electronics

Talking pictures are a cinch with 8-mm Camra-Corder, using a high-quality zoom camera and a direct-coupled tape recorder for perfect sound-picture sync; $330 from International Camera Corporation, New York

Pickup on tangent eliminates tracking error to reduce distortion, maintain stereo balance and give near-perfect reproduction. Tangmatic costs $175; from John Bullock, Northridge, Calif.

Cordless tape recorder the V-M Charger, runs 4 hours on nickel-cadmium pack, recharges on a.c. Unit has a 2-speed capstan drive, 6-transistor circuit and good sound

Turn-around stereo-TV combination is a new twist that combines a stereo console system with a 19-in. television receiver. For viewing, one of the stereo speaker cabinets swivels around to reveal the TV. For music, the TV is swiveled out of sight. Marquette Corp. is the manufacturer of the turn-around unit

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Ford Bronco/66

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How Many Beans in the Jar?

(Continued from page 97)

contest jar. If we can measure the dimensions of the contest jar, we can use these measurements to find the volume. For instance, if the jar is a sphere, the volume V is given by the formula $\pi D^3/6$ where D is the diameter of the sphere and $\pi = 3.1416$.

Even if the jar is of unusual shape, it still is generally what is known as a surface of revolution. That is, the surface swept out by a curve which is revolved about a fixed line (called the axis of revolution). For a football (ellipsoid of revolution) we have $V = \pi LT^2/6$, where L is the length and T is the greatest thickness. The volume of more complicated shapes can often be found with the help of calculus.

For really irregular jars and for jars that contest rules forbid you to handle, more complicated methods are needed. One can estimate the volume by taking photographs from a number of angles, or by using surveying equipment. Then the various measurements can be interpreted by statistics, another branch of mathematics, which will give a volume estimate and an idea of the errors involved.

Don't Forget Thickness

The volume estimates we have made are of outer volume. We want the inner volume, so we must be careful to correct our figures for the thickness of the container. Once we have a volume estimate, we can estimate the number of beans by using our own beans and containers.

Suppose we cannot obtain a supply of beans (peas, ball bearings or other objects) like those in the contest jar. Then, estimating is more difficult. One way is to again count how many beans are touching the inside of a "window" that you have marked off with adhesive tape on the outside of the jar. From this we get the average center to center spacing of the beans. This tells us how much room an average bean occupies. From this we can determine how many will fit in the jar's volume.

Finally, there is the psychological angle to consider. People tend to use round numbers in their contest guesses, as well as in daily life. For example, every census shows that there are more people who claim to be 35 than either 34 or 36! So if you think the number of beans is between, say, 8000 and 9000, don't guess 8000, 8100 or 8200. A round number has no more chance than any other of being correct.

But now you're on your own. Go out and find a rousing contest in which to test your skills. And if you lose, console yourself with the thought that all those beans you bought are edible. ★ ★ ★

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CHEVROLET

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Pattern Your Shotgun

(Continued from page 175)

be done by an experienced gunsmith, unless, of course, you have had experience in this exacting work. But many of the variables can be corrected simply by altering handling practices.

Many trapshooters, also skeet shooters and hunters, like to "float" the bird, that is see it over the gun barrel or barrels, and to determine even more precisely where the gun throws its charge they often pattern from a rest. A sturdy card table will do for this testing. You'll also need a small box and padding to serve as a rest for the gun barrel or barrels. With this setup it's the usual practice to let off each shot just as the sight touches the lower edge of the bull. Here a steady hold is important and at first you may have a little trouble with trigger pull, which usually is somewhat heavier on a shotgun than on a rifle. Also, one may have to become accustomed to the relatively heavy recoil of a shotgun, especially in larger gauges and with magnum loadings. If you flinch, the shots will go wild.

Center Line of Sight over Rib

When properly carried out, this test will show just where the gun places its charge relative to the aiming point. Also, it offers opportunity to test placement of charges from the right and left barrels of side-by-side doubles and over-under guns. Your line of sight in this test.—as in those described previously—should be about ¼ to ⅜ in. above the breech and one should be sure the line of sight is centered over the rib before firing.

If desired, patterning tests can be carried farther to determine other governing factors and a "best" load for your particular gun. In patterning for a best loading you may discover a special compatability of your gun for a certain factory or hand loading in light, medium or heavy chargings of powder and shot. One scattergun may consistently turn in its best patterns with a magnum loading. Another of the same gauge and boring may perform best with a light target (skeet or trap load) or field loading. In this testing, as well as those described previously, you may have to fire a dozen or more shots to reach a more or less definite conclusion.

The perfect pattern is a consistent uniformity of shot distribution inside a 30-in. circle at ranges suitable to the boring—40 yds, for full choke (12, 16 and 20 gauges), 30-35 yds. for modified and improved modified borings and between 20 and 30 yds. for the skeet and improved cylinder and full cylinder borings. Shot distribution should show a reasonably consistent uniformity at these ranges. There should be no large, irregular holes in the pattern print and no undue bunching or cartwheels, and only a small number of flyers, the latter deformed pellets which land wide of the main concentration. If you fire the newer shot shells with combined plastic shot cups and wad columns, you may see few, if any, flyers. The 28-gauge and .410-bore guns usually give the best pattern prints at the shorter ranges, 25 to 30 yds. average, and these generally perform best with the smaller shot sizes, such as No. 7½, 8 and 9.

Determining Shot Percentages

It's easy to arrive at the shot percentages. Make a simple compass of 15 in. radius like that detailed, lay the pattern sheet on a flat surface, determine the greatest concentration of pellet holes and strike a circle around this area. Then, using a felt marker, mark the shot holes in the paper within the 30-in. circle, counting as you go. Some testers count the shot holes on the line as well. Then, for example, if there are, say, 300 holes in the circle and the average number of shot pellets per shell is 400, then 300 times 100 divided by 400 equals 75, or a 75 percent pattern. These are only convenience figures, of course, but they show how percentages can be arrived at. The percentages will vary somewhat from shot to shot and if you desire a further average, then it will be necessary to fire a minmum of 10 shots or so to determine this figure. ★★★

Solenoid Toy Engine

(Continued from page 197)

a press fit over the ends of the crankshaft and held with soldered washers.

The solenoid is energized by two spring-wire contacts, one of which bears against the crankshaft continuously, while the other only intermittently. The latter makes contact with a ½-in. steel disc, drilled off center to serve as a cam, and pressed over the end of the crankshaft. When the cam is in contact with the wiper wire for ½ revolution of the flywheel, electric current energizes the solenoid coil and pulls the plunger back to provide the power stroke. At the split second the wiper wire breaks contact with the cam, the plunger is de-energized and returned to its forward position by the momentum of the flywheels and the cycle repeats. The engine will run on any toy-train transformer, as well as dry cells. The number of cells required will depend on the rated voltage of the solenoid to be used.

—*W. D. Siprelle*

All About Gutters

(Continued from page 164)

there. Two representative types of guards are shown on pages 160-161. Aluminum guards should only be used on aluminum gutters. For unpainted galvanized gutters, buy a galvanized-mesh guard. Should you not want to go to the trouble and expense of installing such guards, or in cases where such a guard is impractical because of the type of hanger used, you can try to get by with a cage-type strainer at the top of each downspout. At least it will keep any large debris from clogging the spout, where it's hard to locate and remove. (In the average system, there should be a downspout for each 30 ft. of trough).

When downspout clogging does occur (you can tell by pouring a bucket of water down each; if it flows out sluggishly at the bottom, you've got a clog) you can unplug it by squirting a hose down it, with the nozzle set for a top-pressure jet.

When you've finished the clean-out, inspect the inside of all troughs for any signs of dry rot, rust or corrosion, and do what patching is necessary. The aluminum-foil-in-black-cement patch demonstrated on page 159, is a cheap salvage job for either wood or metal gutters. Or use a self-adhesive metal repair tape of the type being applied to a downspout on page 162.

Now let's climb up onto the roof itself and take a look at your flashing. *PM* questioned several roofers and learned that nearly half of the repairs they undertake can be traced to flashing failures. This isn't surprising, since the roof is only as good as the seals along its valleys (where two roof-planes meet) and around the chimneys and vent pipes that poke up through it. To turn weather back at these points, roofers put in strips or sheets of galvanized steel, aluminum or copper. But it must be put in right.

"Just did a reflashing job on a five-year-old home," one roofer told us. "A ½-in. gap had opened up between the chimney and the roof. This wouldn't have mattered if the flashing had been installed right, but the guy had tried to cut a corner by using a single piece on each side of the chimney, instead of a separate step and counter. When the house settled, something had to give."

This puts a finger on one vital aspect of flashing. Any frame structure is bound to settle. The chimney, however, stands firm on the foundation, so the flashing must be designed to close any gaps that develop as the roof shifts. The standard lapped-sheets system is diagrammed on page 163.

Another roofer told us: "This lady's roof was leaking like a sieve. When I pulled off the shingles along the valley, I found the flashing eaten away. The character who installed it had used galvanized nails to fasten aluminum flashing." It's the gutter tip again: never mix metals.

When you suspect your present flashing is inadequate, it's often too much of a chore to pull it all up and replace it with new—especially where it's covered by shingles. But it's not difficult to *reinforce* it, creating a fresh seal. And you needn't worry about metal-mixing or roof punctures if you use asbestos felt or fiberglass flashing set in black plastic roof cement. You can buy these materials from any roofing supplier. The black cement is not ordinary roofing tar; it's asbestos-fiber packed, and runs as high as $3 a gallon.

With a cold chisel (or screw driver) prod the mortar joint into which the rolled top edge of the chimney's counter flashing is inserted. If mortar crumbles and falls out to any great depth, this joint should be remortared. If only the top surface chips away, leaving solid mortar beneath, put a layer of the cement over the joint, after brushing away loose particles.

The method of reinforcing valleys is identical to that demonstrated in the roof-to-wall-joint photos on page 164. Just apply a band of cement down the length of the valley, extending 2 in. to each side. Run a strip of flashing material down this band, pressing it firmly and evenly in place. To make certain the edges are sealed, run a bead of cement along them.

Now, *let* the storms come! ★★★

Rattle Up a Deer

(Continued from page 108)

the best time to make your rattling calls carry.

"Deer react to rattling in different ways," says Tinsley. "An eager one might plow right in on you, with blood in his eye. A more wary one might sneak around, looking and listening, reluctant to come closer. Often, in this case, a hunter should beat the antlers on the ground and slam the brush, to give the impression of a heated fight. The idea is to work on the buck's emotions until he can't stand it any longer."

Rattling your trophy buck within gunshot range works best when the open season on deer corresponds to the rut and a high ratio of bucks exist in the area you plan to hunt. In the western part of the country, where many trophy bucks are taken annually, "rattling" is becoming more popular among sportsmen since dense brush prohibits hunting deer by any other method. But it can be just as productive in the woods of the East. ★★★

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Village Blacksmith

(Continued from page 107)

came time to bring in the hay it was cut by about six men with scythes, each swinging that heavy tool in monotonous rhythm all day long. There was no break except an occasional pause to whet the blade of the scythe, and a single stop in the middle of the morning or afternoon to visit the spring and there drink from a jug that strange nonalcoholic brew called "switchel," which my aunt had prepared shortly after dawn. Later in the season came the reaping of the oats, when the same process was repeated, except that the men swung cradles instead of scythes. And since neighbor helped neighbor, the six men went on day after day teaming together until the fields of all had been cut. No modern production line could possibly be so monotonous an undertaking, and surely none could be so physically exhausting.

Today, most of this dreary hand labor has been eliminated. Harvesting is done with magnificent, but complicated, power equipment. The farmer who drives the mowing machine, or the reaper and binder, not only produces infinitely more than his grandfather did, but must be far more of a man. No wool-gathering for him as he works! If he lets his mind wander just once he will be quite certain to wind up in the creek.

Tremendous change and improvement are likewise now going forward in the techniques of industrial production. Alert management everywhere is striving to give the individual employee the greatest possible opportunity to make a significant contribution to the success of the enterprise. Automation, while temporarily reducing the number of jobs required, greatly raises the level of skills demanded in those that remain. The supercraftsman who staffs the new equipment, like the farmer on the modern reaper, must be much more of a man than his predecessor ever was.

Sense of Achievement

No one can convince me that the skilled worker in a steel plant today—and nearly all such employees must be highly trained—does not feel the same thrill of achievement and the same pride of craftsmanship that shone on the face of my village hero when he had completed a particularly difficult task. Watch the maintenance man in a rolling mill when an unexpected cobble occurs and the swiftly moving stream of hot metal suddenly begins to pile up. All eyes are on him as he rushes to the spot.

(Please turn to page 214)

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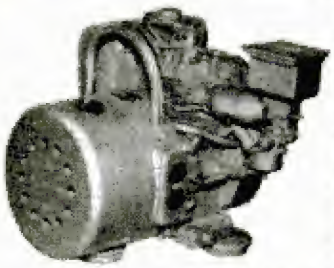

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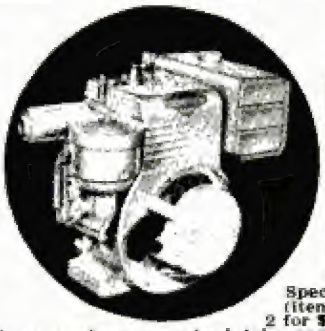

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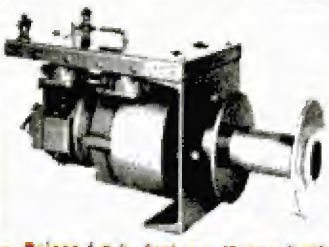

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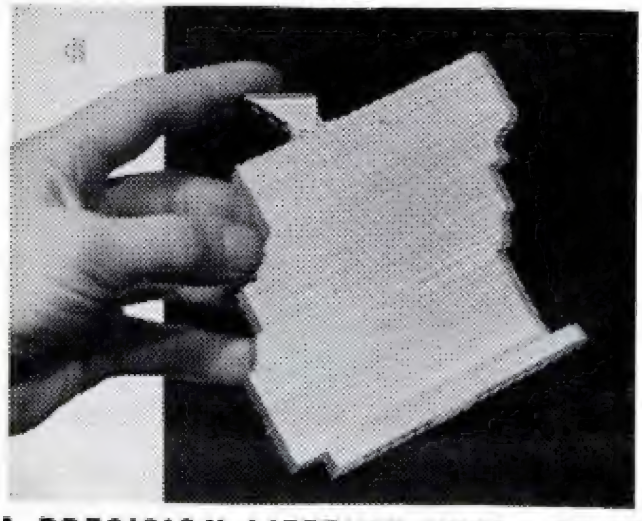

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P.O. Box 867-PM, Ft. Worth 1, Tex.

Village Blacksmith

(Continued from page 212)

No two such mishaps are alike, and this man feels the same trepidation that the blacksmith did when a horse which he had never seen before, and which he was trying to shoe, suddenly began to kick. The mechanic must make up his mind in a split second what to do, and if his quick and decisive action turns out to be right and the machinery begins to move properly once more, the glow of pride shining from his countenance tells more vividly than words the depth of satisfaction which has come to him.

There is, of course, one further break with the past, and it is one that nothing can be done about if we are to maintain the forward thrust of our economy. Large-scale production and nationwide marketing make it impossible for the particular individual who has mastered his craft to be identified, in the mind of the consumer, with the article sold. The purchaser of a new automobile never knows the name of the imaginative draftsman whose creative mind first conceived the change in design for the new type of fender, let alone the name of the company which produced the steel, or that of the maintenance man who kept the rolling mill from breaking down.

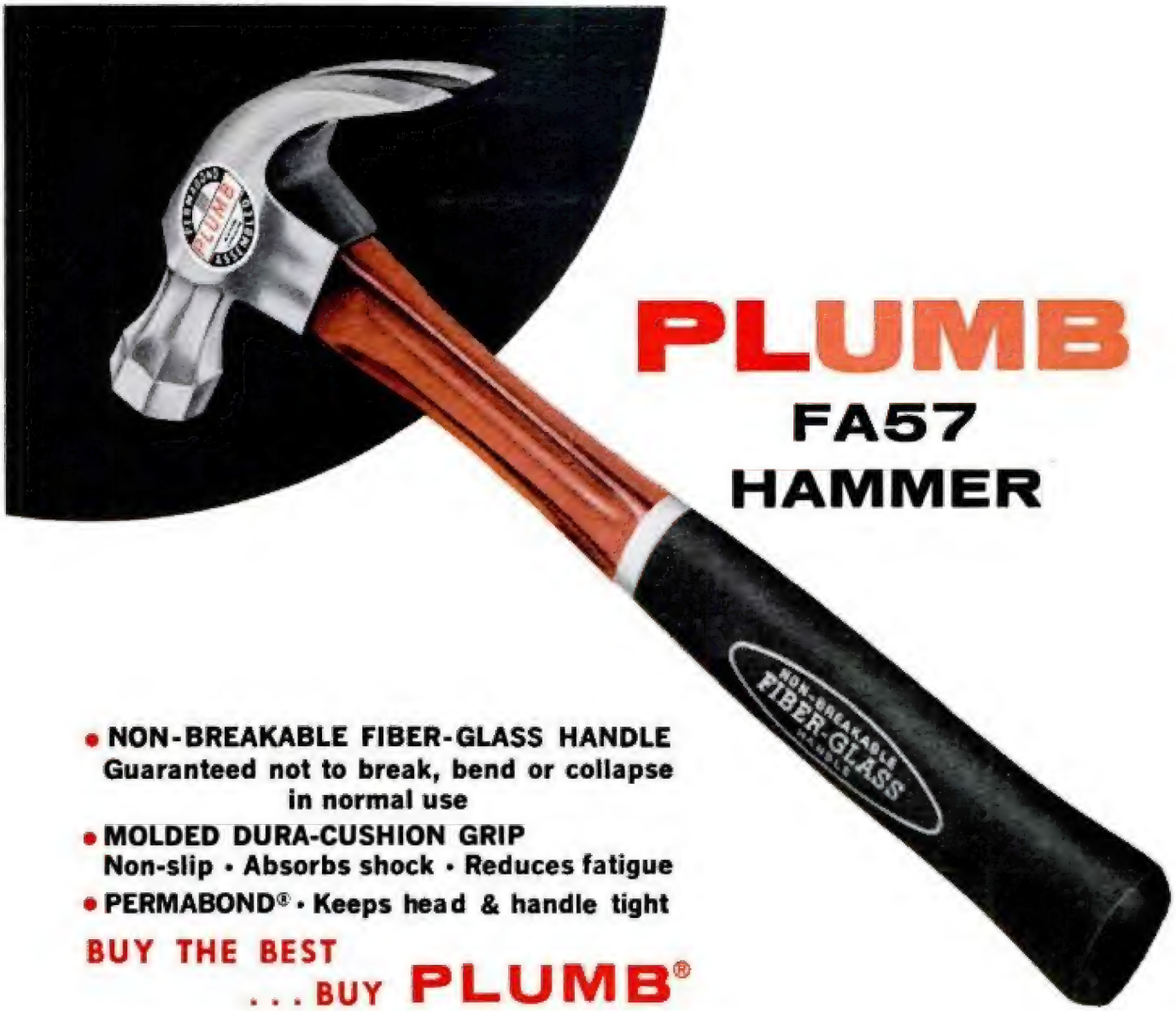
Time for Hobbies

That is the price we must pay for our vastly increased standard of living. But there is a marvelous offset: the increase in leisure time which has come into the lives of workers. When I first came into industry, a working day of two 12-hour shifts and a work week of six days were still common. Under those conditions, the man who had but 12 hours to himself, out of which had to come time for meals, sleep and travel to and from his place of employment, had no spare time for an opportunity to develop his handicraft skills.

Today the door of opportunity stands wide open for those who have the self-discipline and the imagination to bring to perfection the manual skills with which nature endowed them at birth. Let us remember that the great art of the world has always been self-generated. It has been created in response to the deep inner urge of the spirit, and has never been a mere function of vocation.

The woman who devotes her winter months to making new drapes for her living room will have for years thereafter a daily reminder of the happiness which she has brought to her family. My mother was never able to do that. To begin with,

(Please turn to page 216)



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Talking Guns

Shooting bullets into water may become a way to signal or navigate at sea. A Navy scientist, who has been firing bullets into water tanks, says differently shaped bullets make different sounds as they enter the water and these could be used to signal a submarine or—combined with an array of underwater microphones—could enable a low-flying plane to determine its position.

Lenses for Skin Divers

Underwater contact lenses that have been tested at depths greater than 100 feet have been developed by a Navy surgeon and a civilian optometrist. For a skin diver with normal vision, the new lenses permit clear underwater vision without goggles or face masks. They can also be ground to a prescription. Bigger than ordinary contacts, the new ones cover most of the eye so that the eyelids help hold them in place. The Navy's interested in them for use by its underwater demolition teams, since face masks and goggles sometimes become a hazard when they jam against the face from the force of an underwater explosion.

Flashy Submarines

Identifying a submarine will be easier for boatmen in the future. The Navy is installing a rotating amber light that will flash 90 times a minute and be visible for three miles on each of its submarines when they're operating on the surface. The low-lying, dark-colored subs have been collision prone in the past because they're difficult to see and are often mistaken by boats for smaller craft.

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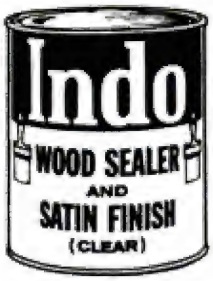

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Village Blacksmith

(Continued from page 214)

there were no fabrics available comparable to the fine ones which any housewife can buy today. But even if these had been available, she had no time. She had no gas or electric range, no washing machine or dryer, no vacuum cleaner. She rushed madly about all day, carrying coal up a flight of stairs for her kitchen stove, washing clothes with a scrubbing board and a galvanized tub (which had to be brought into the kitchen from the back porch) and filling the tub with water that had previously been heated in kettles over a long time.

"Do it yourself" is now a national pastime. Many a homeowner not only paints his own house, but puts a new roof on it. On winter evenings he may be in the basement making a new table for the playroom. On Fourth of July weekends, when I see a stream of boats on trailers heading north and northwest out of Chicago for the Wisconsin lakes, I know that many of them were built in garages over the winter.

Up to the Individual

The variety of personal skills which may be developed on a spare time basis is infinite. It all depends upon the will of the individual to improve himself. I had a friend whose father had actually been a village blacksmith. So to perpetuate the family tradition he put a forge and anvil in his basement, and turned out extraordinary bits of ironwork for the benefit of his neighbors.

I know a banker whose passion is music and who can hold his own playing alongside professionals in a community symphony orchestra. And if the primitive tribes in Africa can produce native carvings which are eagerly sought by the great museums of the world, why cannot we Americans with a number of modern precision tools at our command do at least as well?

So let us not waste time in being sorry for ourselves by looking back nostalgically to the days when the man who made the pump handle also brought it to the kitchen and installed it. Let us rather accept the fact that the days of the village blacksmith are gone forever, and be grateful for the change.

Let those who lament the passing of human skills in industry set an example in their own communities by demonstrating how effectively their creative effort can find expression during their growing periods of leisure time. ★ ★ ★

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They're Burning a Memorial

(Continued from page 137)

original steel-support structure, enabled workmen to operate safely.

Next, modern industrial jet torches were purchased and improved upon to do the job. Burning a mixture of kerosene and liquid oxygen, these water-cooled torches are actually miniature jet engines capable of burning a channel 3 inches wide, 4 feet deep and 20 feet long into solid granite in two and a half hours. Their cutting flame roars from the torch's mouth at a velocity of 2800 feet per second and a temperature of from 3000 to 3500° F.

Directed by George Weiblen, who worked with Lukeman in 1928, this new breed of mountain carvers uses standard engineering techniques to plot dimensions of the original models in their proper scale on the face of Stone Mountain. Next, holes are drilled into the granite at key points, their varying depths indicating the precise amounts of stone to be removed by the big jet torches. After the heavy cutting is completed, a smaller torch is used for more detailed work. The final step consists of smoothing contours.

Roy Faulkner, chief carver at Stone Mountain, is enthusiastic about the technique of burning in modern mountain carving. "The torches give us a much cleaner finish than blasting," he declares. "Blasting produces tiny spiderweb cracks which penetrate deep into the stone. Over the years they will tend to enlarge due to moisture penetration and changes in temperature. Burning off the granite with torches leaves no such cracks. When we finish an area there's not a crack anywhere. It's all perfectly solid.

"On the other hand," he continues, "We have to remember that there's an element of danger in using these torches. "If the fuel hoses should rupture and ignite, catching a man on the scaffold, he would either have to jump or burn to death. There would be no way to escape."

During the first seven months they were in use, the torches burned off as much stone as could have been removed in from 18 to 24 months using older methods.

To achieve the relief called for by the sculptor's original models, the workmen have penetrated as deep as 12 feet from the carving's outer plane, and a total distance of 42 feet inside the mountain's face. They are a dedicated group who enjoy their unique work and look forward to finishing in a minimum of time.

"After all," Roy says, "when the job is done we want everybody who sees it to be proud of it." ★★★

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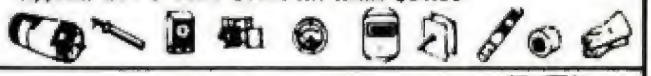

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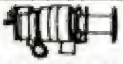

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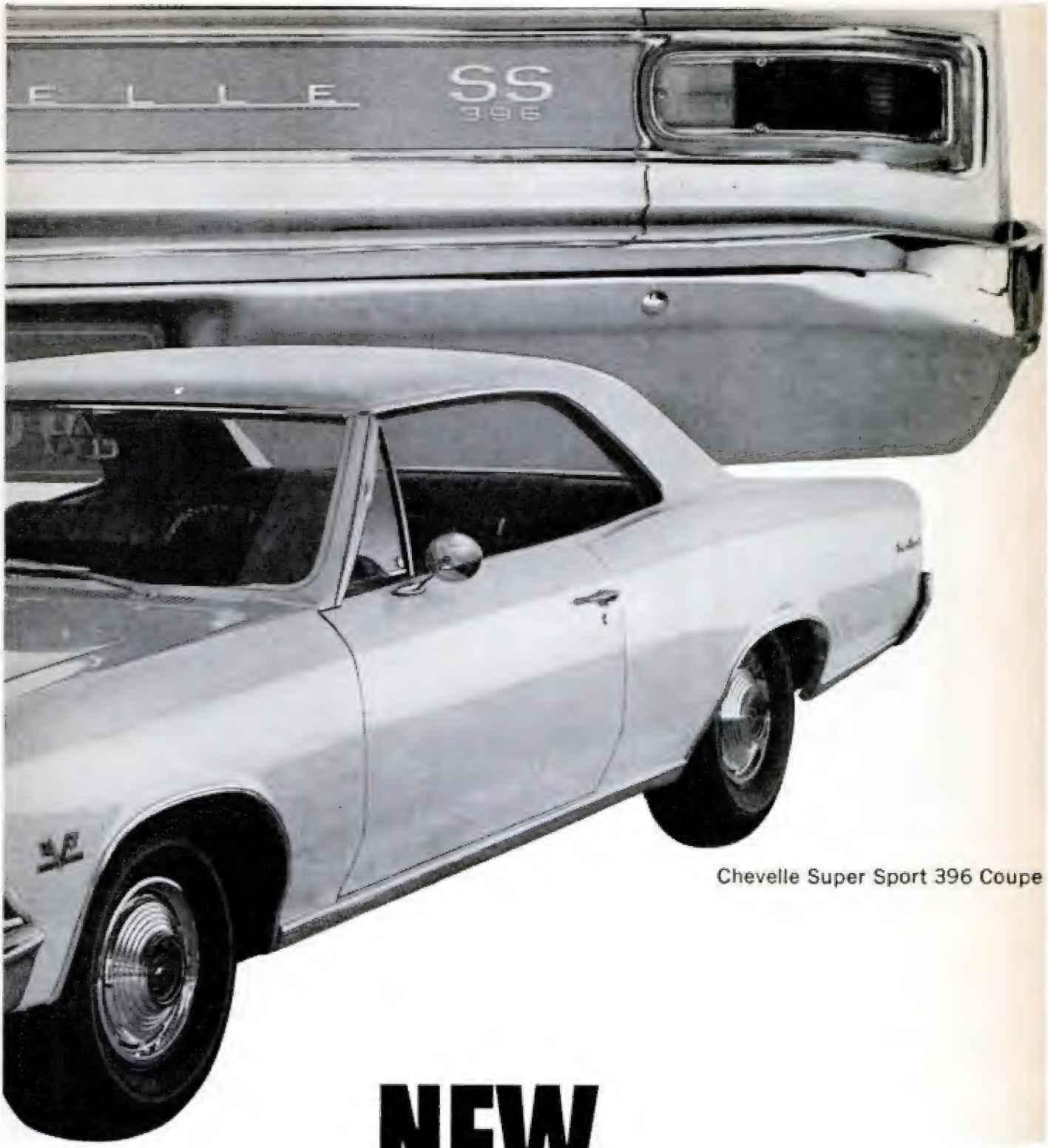

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Brain Control by Radio

(Continued from page 132)

among the brains of different persons. That is, stimulation of the same region of the brain in different persons can produce quite different behavioral responses. The reason for this, according to Dr. Delgado, is that the organization of brain physiology —the way it works in directing thought and action—depends greatly on the experiences a person has had.

Factors Modify Effects

Another reason is that stimulations of the brain do not produce blindly automatic responses. ESB can often be overridden or modified by other mental or physical activities of the individual. Thus, the stimulated reactions become integrated into social behavior according to the individual's own personality, experience, desires, drives, and attitudes, and depend also upon the circumstances in which the stimulus was given.

For example, the stimulation of at least five regions of the monkey brain which produce aggressiveness will send the animal into a rage. Usually, however, it will not attack just any member of the colony. Rather, it will tend to make "intelligent" attacks on monkeys that are challenging its authority or weaker than it.

"The behavior of a group of monkeys," says Dr. Delgado, "is an entertaining spectacle, and a few minutes' observation gives the impression that their playing, grooming, chasing and comic activities are rather unpredictable. Long-term studies, however, have shown that individual and social behavior is predictable within a known range of variability. The study of group behavior is possible precisely because of the recurrence of patterns which can be identified."

The Spanish-born neurophysiologist identifies such patterns by making time-lapse motion pictures of his monkey colony, taking one frame every few seconds day and night (when infrared illumination and special film are used) and then scoring each monkey on various measures of behavior, such as walking, sleeping and picking. By assigning units of time and space to those activities—how long a monkey groomed, how far it walked—Dr. Delgado develops a complete behavior profile for each animal for purposes of comparison.

One experiment involving such an interaction and mutual effect of stimulated and nonstimulated monkeys revealed that one monkey could learn to use ESB to control the behavior of another.

That was done by connecting a radio

(Please turn to page 224)

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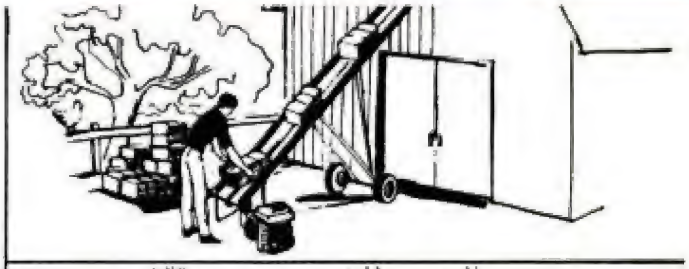

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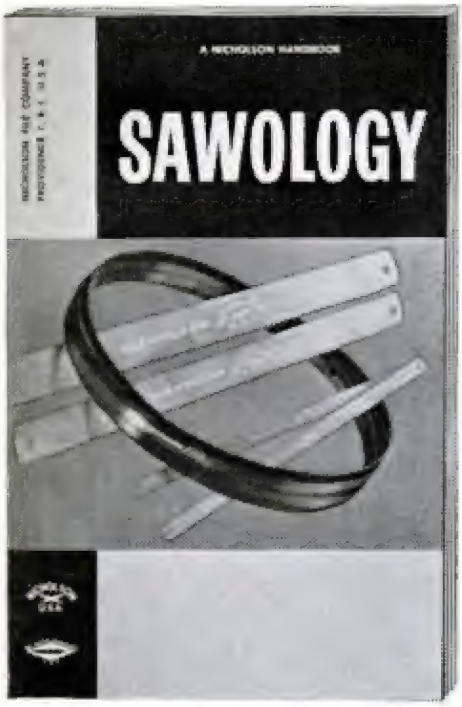

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Brain Control by Radio

(Continued from page 222)

transmitter to a lever put through a hole in the wall of the cage where the monkeys could press it. When they did so, a radio signal would stimulate a region of the brain of a particularly hostile monkey and inhibit its aggressive behavior. Dr. Delgado explains that it took only a few days for the most harassed monkey in the colony to learn the value of that lever and to use it whenever it was chased.

Busy Monkeys

Another experiment involved what Dr. Delgado calls sequential behavior. Stimulation of a region of the brain called the red nucleus caused the following series of activities: The monkey stopped what it was doing, changed facial expression, turned its head to the right, stood erect on two feet, climbed a pole, descended to the floor, made low vocal sounds, threatened other monkeys, changed attitude and peacefully approached others, and finally resumed what it had been doing.

The most remarkable thing about that and other similar performances is that the whole sequence would be repeated again and again whenever the red nucleus was stimulated. Only details in the activities varied, and then just to allow the monkey to avoid obstacles, to run from a threat, to eat and sleep. The "remarkable reliability of responses" was maintained, according to Dr. Delgado, even in an experiment that involved more than 20,000 stimulations given every minute for two weeks.

How does the application of an electrical charge to a region of the brain elicit so complex an array of responses so reliably? No one knows yet, but Dr. Delgado believes that ESB serves merely to trigger a highly complex system of nerve connections which normally are activated by other factors, such as emotional perceptions, memories and motivations of various kinds.

"The uniqueness of voluntary behavior lies in its wealth of [such] 'starters,' each one of which depends on a vast unknown integration of past experiences and present receptions," explains the doctor.

Determining how those vast and unknown integrations produce social behavior will require the development of major new theories, Dr. Delgado believes, because the materialistic theories of today "are not sufficient to explain reality."

The task of ultimately explaining reality, he thinks, will demand the exploitation of what he calls "the most suitable kind of feedback mechanism: the human brain studying the human brain." ★ ★ ★

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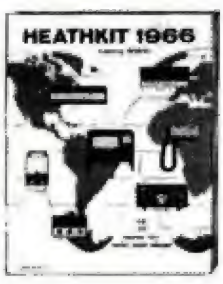

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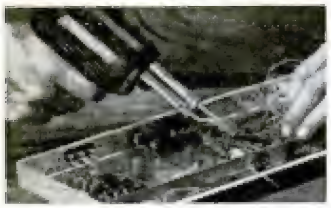

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Giant Steps to the Moon

(Continued from page 120)

After you've built a 365-foot rocket and strapped it to a 446-foot tower, how do you get them out of the building? You roll them right through the garage doors, of course. Each bay has a huge opening shaped like an inverted T. The doors at the bottom of the T roll horizontally, like barn doors, to permit the 140-foot-wide base of the launching tower to pass through. Seven overhead doors, on the stem of the T, slide up and stack at the top of the building. Although faced with aluminum, these seven doors each weigh from 32 to 73 tons.

The crawler-transporter, heart of the facilities, is by far the largest and most complex land machine ever built. It moves on eight steel treads, each with 47 links or shoes; and each seven-foot-long shoe weighs more than a ton. Thus it wears almost a million pounds of footwear.

The entire machine weighs 5.5 million pounds, and has the muscle and precision to balance a skyscraper twice its weight. Loaded with the moonrocket and its mobile tower, this odd vehicle will weigh a walloping 17.5 million pounds. It would sink out of sight in the Florida sands if it wandered off its special roadway.

The highway, already built, runs only 3½ miles, from VAB to the launching pads. Eight feet thick, it is built up of highly compacted fill and crushed rock, then paved in parallel strips 90 feet apart.

The width of the roadway is comparable to that of an eight-lane divided expressway. But this expressway to the moon has the lowest speed limit of any road ever built. The moonrocket will be trundled along at about one mile per hour. The most ticklish part of this trip will be the ramp climbing to the top of the pad, 48 feet above grade level.

The crawler, after depositing its load, will rumble to a nearby parking lot and return with the mobile arming tower. This structure, almost as high as the launch tower, will give technicians access to every part of the space ship as they fuel it and install the rockets.

These are the most dangerous hours. The highly volatile fuel could unleash an awesome amount of energy. If any spills on the pad, an alarm would sound, and anyone on the launching tower immediately starts the wildest trip ever devised. First he'll scramble into the high-speed, self-service elevator and push the bottom button. Within 36 seconds the door will open onto the deck of the tower base.

Then he will leap out the door, dive

(Please turn to page 230)

MONTGOMERY WARD

Lace 'em
You'll love 'em

Lacing couldn't be easier than with these Montgomery Ward boots. You do it with one pull. The boots are built for comfort, too . . . and protection from the elements. They have oil-treated leather uppers, insulation throughout and . . . oil-resistant Du Pont Neoprene on the bottom. Soles and heels of "Neoprene" mean long wear in a QUALITY boot. Buy Speed Lacers at any Montgomery Ward Retail or Catalog store or order by mail from Ward's Fall Catalog.

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Synthetic Rubber

Better Things for Better Living
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F.p.s. (feet per second) means velocity. You get more of it in a Remington "Hi-Speed" 22 with "golden" bullets. More f.p.s. at 50 yards than ordinary 22's have at the muzzle! Greater penetration and wallop. In shorts, longs or long rifles, solid or hollow point. See your Remington dealer.

"Hi-Speed" is trademark of Remington Arms Company, Inc., Bridgeport, Conn. 06602.

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MEN PAST 40

Troubled With Getting Up Nights, Pains in Back, Hips, Legs, Nervousness, Tiredness.

This new Free Book tells that if you are a victim of the above symptoms, the trouble may be traceable to Glandular Inflammation . . . a condition that very commonly occurs in men of middle age or past and is often accompanied by despondency, emotional upset and other mental and nervous reactions.

The book explains that, although many people mistakenly think surgery is the only answer to Glandular Inflammation, there is now a non-surgical treatment available.

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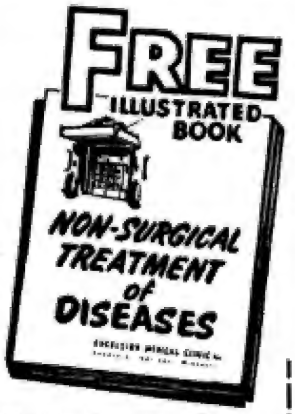
This New Free Illustrated Book tells about the modern, mild, Non-Surgical treatment for Glandular Inflammation and that the treatment is backed by a Lifetime Certificate of Assurance. Many men from all over the country have taken the NON-SURGICAL treatment and have reported it has proven effective.

The Non-Surgical treatment described in this book requires no painful surgery, hospitalization, anesthesia or long period of convalescence. Treatment takes but a short time and the cost is reasonable.

REDUCIBLE HERNIA | HEMORRHOIDS

Non-Surgical treatment for both Reducible Hernia and Hemorrhoids, the book explains, can usually be taken at the same time as treatment for Glandular Inflammation.

This new Free Book is fully illustrated and deals with diseases peculiar to men and women. It tells HOW and WHY New Modern NON-SURGICAL Methods are so successful today. Fill Out Coupon.



Excelsior Medical Clinic, Dept. M 6150 Excelsior Springs, Mo.

Gentlemen: Kindly send me at once, your New FREE Book. I am interested in full information. (Please Check Box)

☐ Glandular Inflammation ☐ Hernia ☐ Hemorrhoids

Name.....

Address.....

City..... **State**.....

Giant Steps to the Moon

(Continued from page 228)

into a three-foot opening and slide 90 feet down a stainless-steel tube coated with Teflon, one of the slipperiest materials ever developed. He'll sail out into a room 60 feet long in the earth beneath the pad.

According to preliminary calculations, he'll be hitting 40 mph when he enters the room and crashes into the far wall. This would be suicidal if the wall were not covered with foam rubber almost a foot thick. However, the wall won't just stop him; it will bounce him back. What direction he takes then is anybody's guess. To solve this rebound problem, the entire room, including floor and ceiling, is covered with a thick cushion of foam rubber, and the fleeing man will bounce like a handball.

When he finally comes to rest, he'll stagger through a heavy steel hatch, slam it shut behind him, and find himself in a hemispherical, cavelike chamber completely isolated from the launching pad by heavy steel springs. Hastily he'll strap himself into a contour chair and contemplate his possible future while awaiting the explosion, just feet above his head, of enough high-energy fuel to blast a 45-ton boulder to the moon.

Such a flight from disaster probably will never occur. For 10 days the rocket will sit peacefully on the pad while technicians pour in the fuel and the astronauts complete their final check-out of the spaceship.

Then, on the tenth day, with the moon moving precisely along its predicted arc, the astronauts will climb into their cramped vehicle. An alarm will sound and everyone will flee the pad. The three men will sit alone atop the biggest bullet ever built, a bullet that weighs as much as the nuclear submarine *Nautilus*.

Their closest companions will be 3½ miles away in a plush room that contains all the nerve endings from the rocket. Designer Urbahn has called the Launch Control Center "not so much a building as an almost-living brain."

Here scores of NASA experts check computer read-outs and watch the TV pictures from 85 different channels built into the pad area. Behind heavy plastic windows, comfortably seated in deep armchairs, VIPs from all over the world watch developments on huge projection-TV screens built into the wall.

The countdown drones on until, during the last seconds, the visitors swing around to peer out through special soundproof windows. The rocket lifts off, slowly gathering speed, until at last, far out of sight, it is hurtling along at 25,000 mph toward its rendezvous 239,000 miles away. ★★★

champing at the bit for a really cool pipe?

LIGHT UP A

Kirsten

Kirsten's patented Duralumin Radiator stem not only produces a cooler draw, but condenses out harsh and harmful tobacco impurities. Moisture easily is removed with a flick of the exclusive Kirsten valve. Featherweight Sportsman model features premium imported Mediterranean briar and hand-finished vulcanite bit. Order yours by mail today. Just $7 Postpaid.

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For boat, home, shop, office, art studio, etc.

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Adjustable two point blade retracts into handle and may be locked in many cutting positions with set screw adjusted with coin.

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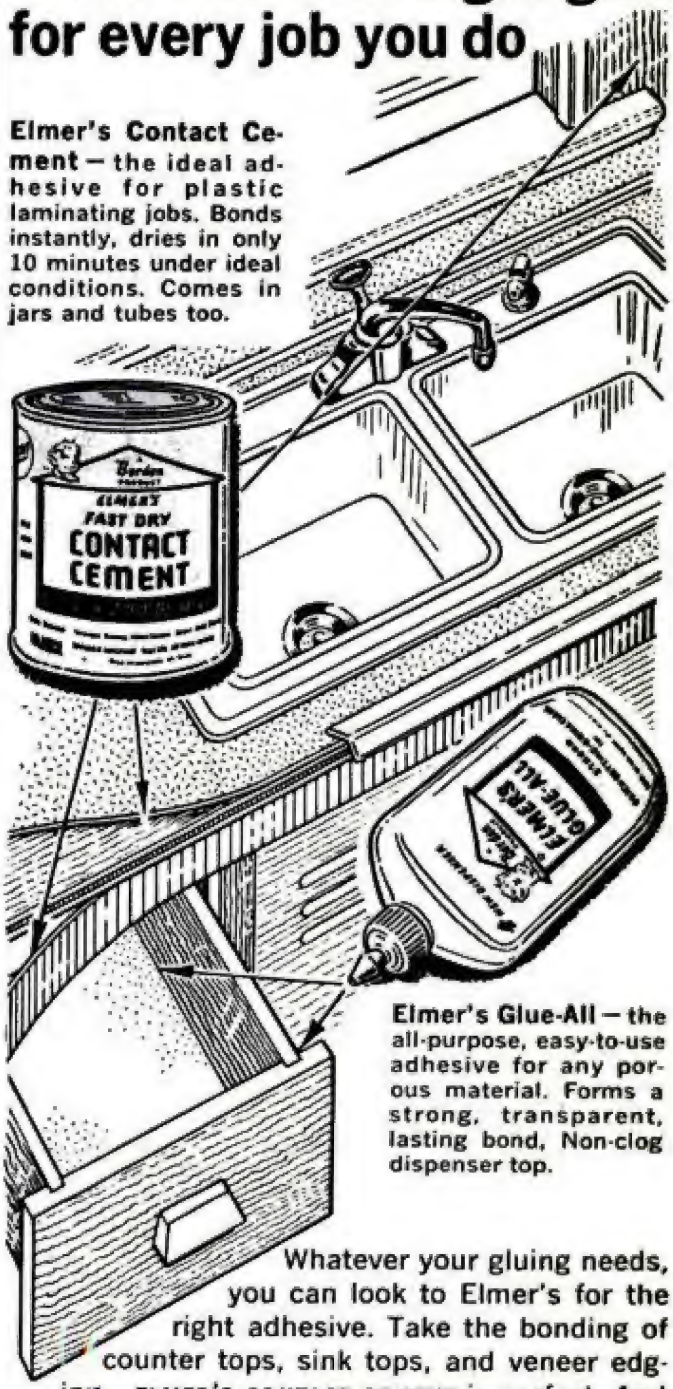
On sale in paint and hardware stores or send $1.00 tool sent postpaid.

HYDE TOOLS
SOUTHBRIDGE, MASS., U.S.A.
Knife with one blade, extra blades five in pak 60¢

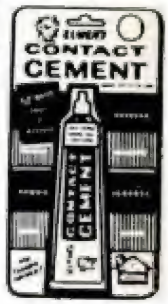
Elmer's has the right glue for every job you do

Elmer's Contact Cement — the ideal adhesive for plastic laminating jobs. Bonds instantly, dries in only 10 minutes under ideal conditions. Comes in jars and tubes too.



Elmer's Glue-All — the all-purpose, easy-to-use adhesive for any porous material. Forms a strong, transparent, lasting bond. Non-clog dispenser top.

Whatever your gluing needs, you can look to Elmer's for the right adhesive. Take the bonding of counter tops, sink tops, and veneer edging—ELMER'S CONTACT CEMENT is perfect. And it's also useful for applying prefinished wallboard to studs and furring, with no need for unsightly nailing. Spreads easily with brush or roller without mixing. For all kinds of cabinetwork and interior construction, ELMER'S GLUE-ALL is rightly called "the best glue in the joint." A favorite of woodworking specialists everywhere. Send a stamped, self-addressed envelope for your FREE copy of "Elmer's Wood-Gluing Handbook." Write: The Borden Chemical Company, 350 Madison Ave., N.Y., N.Y. 10017.



BORDEN CHEMICAL

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Ronson introduces the
(Complete with large-

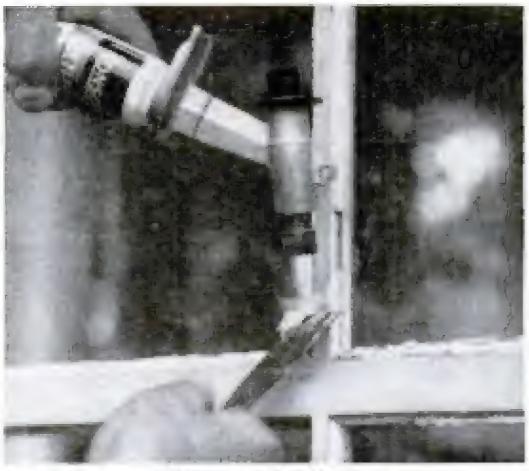
Burns for hours on butane gas. Adjusts from pinpoint to

STARTS LOG FIRES.

MELTS ICE.

STARTS CHARCOAL FIRES.

REMOVES PAINT.



SOFTENS PUTTY.

FOR HARD-SOLDERING METALS SUCH AS THIS METAL CHAIR.

O.K. You own a hammer, a chisel, a screwdriver—a lot of good, hardworking tools.

So when something at your house needs fixing, you're ready, willing and able to go to work.

Or are you?

Ever try to thaw a frozen water pipe with that hammer?

Or unstick a cracked floor tile with that screwdriver?

Or chip ice off the front steps with that chisel?

Humiliating, isn't it?

(Not having the right tool at the right time can make you feel about as self-sufficient as an old-maid schoolteacher fixing her first flat tire.)

But now Ronson has a new torch that can do all those things. And more.

You don't have to be a handyman to put it to work. It starts charcoal and log fires quickly. It burns leaves and caterpillar nests. You can even use it to put a nice brown meringue on Baked Alaska!

It weighs less than 13 ounces. Much smaller than other leading torches, it takes very little storage space. It's as compact and easy to handle as a flashlight.

A blast from this torch can spot-kill a weed faster than you can yell "Crabgrass!"

A broken wire fence needs mending?

This torch can do a perfect soft-solder job in less than a minute.

It can hard-solder a ½" copper tube to a brass elbow in just a few minutes.

It can help remove old paint.

Soften old putty.

Fix a kid's toy.

Help refinish furniture.

Sweat copper tubing.

(Whew!)

Loosen rusted pipe fittings and connectors. (Just try to get in and around pipes and fittings with a larger torch.)

Free frozen nuts and bolts.

And even stand up like a laboratory burner.

(This comes in handy when you need both hands free.)

How did Ronson put this new torch together?

We used butane gas, and the

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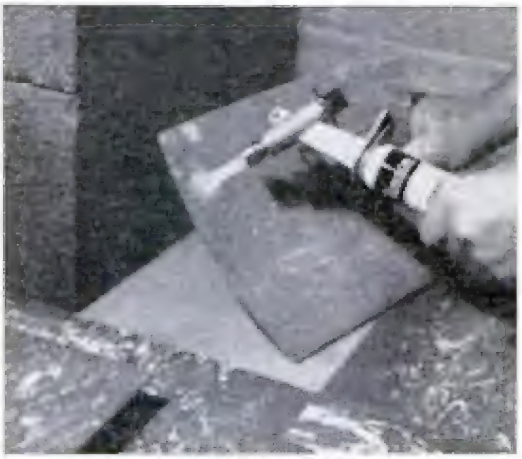
*SUGGESTED RETAIL PRICE.

Varaflame Torch. $4.95.*

size butane Multi-Fill.)

blow torch flame. Lightweight. Compact. Easiest to handle.

BURNS OUT WEEDS
AND CATERPILLAR TENTS.



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ASPHALT FLOOR TILES.

SWEATS AND THAWS PIPES.

SOFT-SOLDERS BROKEN TOYS.

FOR BENDING GLASS TUBING AND
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COMES APART EASILY
FOR STORAGE.

same Ronson Multi-Fill® injector that fuels our gas lighters.

(The Multi-Fill injector lasts for hours, but when it runs dry, you can buy a new one almost anywhere in town.)

And we developed an entirely new kind of torch head.

It snaps onto the Multi-Fill injector. You don't have to be a professional plumber to use it.

A fingertip knob controls the flame precisely. You get the bluest flame possible. The steadiest pinpoint flame. (The steadier and bluer the flame, the more intense the heat, the faster the job gets done.)

And you won't have to take this torch apart to clean it between jobs. It's completely self-cleaning. **It just won't clog.**

Now.

Where can you get your hands on the new Ronson Varaflame Torch?

Anywhere hardware is sold. The price, complete with large-size, 76 gram Ronson butane Multi-Fill injector, just $4.95.*

Isn't that a small price for this amazing torch?

RONSON®
Varaflame
Butane Torch

QUESTIONS ANSWERED

HOMEOWNERS' CLINIC

Chilly Ankles

Our TV room is on the lower level of our bi-level home and the concrete floor is tiled. In cold weather we feel drafts just above the floor level. We've been told that the only cure for this is to lay down a good thick carpet. This would be quite an investment. Isn't there any other way around this problem?—R.F., Me.

Except in homes having a radiant-heat system built into the floors, any carpeted floor will be warmer than a bare floor. But those ankle-height drafts suggest yours is a forced-air system with cold-air intakes in the room in question. If these are located at or near the baseboard level they *will* act to draw cold air across the floor, creating drafts. This will be especially noticeable when the furnace fan is on. If this is the problem, carpeting would do nothing to correct it. Installing adjustable louvered vents in the cold-air intakes might lessen the drafts. But I would suggest you call in a heating contractor on this one.

Water Heater Worrier

My new water heater appears to have an overflow pipe but I don't see anything on it that looks like a safety valve to keep the tank from blowing up if the thermostat should get stuck and fail to shut off the burner. Do these newer water heaters have some other type of safety gadget for this purpose?—O.S., Mont.

A booklet describing installation, maintenance and operation should have arrived with your new water heater. If it didn't, request one from the manufacturer. The booklet will show that the heater is fitted with a fusible plug, usually installed at or near the top end of the overflow. This plug serves the same purpose as a safety valve. It fuses at a preset temperature and releases any dangerous pressure build-up. In addition, most heaters have one or two blowout plugs which pressure would force from the side of the tank should the fusible plug for any reason fail. Happily, water heaters which are being manufactured today are far safer than those of yesterday and, of course, do a much more efficient heating job.

check these features

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MORE ROOM
FOR '66!
NEW PICKUP

• New powerful 1300 cc 4 cylinder engine • New 250 watt alternator • 4-speed "stickshift" • Torsion-bar stabilizer • Big 6' bed—up to 2000 lb. payload • More cab room—more load room • Longer overall—wider—heavier—more rugged • Delivers loaded—heater, WSW tires, vinyl interior, outside mirror, even a cigarette lighter • Saves up to 50% on operating costs with up to 31 mpg • economy and low maintenance design.

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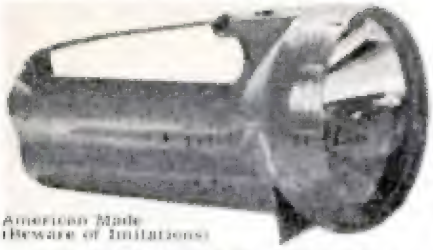

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Made to pierce murky depths and withstand pressures of underwater operation. On land its beam leaps out for twenty miles. 72,000 candlepower illuminates objects clearly a mile away. Pierces smoke-filled areas. Stands alone on special foot. Floats in water. Unbreakable lens. You can jump on this flashlight.

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3 at $8.95 ea. ..... 6 at $6.95 ea. *Postpaid*

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RECHARGER—Made for Beamlight

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- *ELIMINATES SLIPPAGE*
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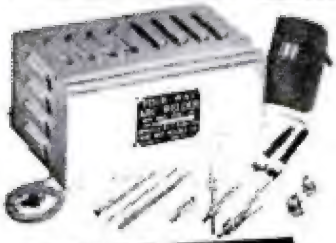

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Hot News in Home Heaters

(Continued from page 113)

vents require a wall opening from 6 to 10 in. in diameter. On the outside, the vent juts from the wall about 6 in. and is about as wide as a salad plate.

Room-size heaters are produced as baseboard, vertical or wall-hung units. Some radiate heat, others move warm air, and at least one heats hot water piping along the baseboard.

You can now make your oil-fired furnace up to 25 per cent more efficient with a remarkably lightweight new combustion chamber liner of ceramic fibers. It's the same material used to cushion heat that builds up the outside of a Gemini capsule.

Hot Water—Hot Air

For further proof that maybe the old oil system still has some fire in the furnace, here's an inspired application:

In Peekskill, N.Y., 150 new split-level homes are getting hot water baseboard heat over the concrete slab on the lower level, and forced warm-air heat in the upper levels. The houses are airconditioned in summer. Here's how it works:

A normal, oil-fired hot water boiler delivers heat to the lower-level convectors, and pipes additional hot water to a set of vertical coils installed in front of the air-conditioning fan. Air crosses the coils, heats up, and is sent through ducts to the upper level. In summer, the boiler line is shut off, and a standard condenser turned on. Cool air flows into the upper level; drops naturally to the lower level.

Despite the ingenuity and efficiency of these existing oil systems, the trend in modern heating is toward gas and electric, and occasionally you can have both.

There is a room-size combination heating and cooling unit that is ideal for an addition on a home. The airconditioning operates electrically, and the heat is fueled by gas. There's one that looks exactly like a window airconditioner. In fact, it will fit through a window, or through the wall, whichever is most convenient.

The very latest twist in electric boilers looks like an ordinary drapery valance. Electrically-heated hot water piping in-

You won't find all the products mentioned here inventoried at your local heating dealer's shop. But if you're really interested in one of them, a letter to the manufacturer will get action. For names and addresses see Page 238.

side the unit sends currents of convected warm air into the room, and frees every square foot of floor space. The same piping delivers cool air in summer.

Electric vinyl sheet is used in a radiant heating system that rolls on the ceiling like wallpaper. Wires are woven into a nylon net which is pressed between two thin layers of vinyl.

The future of heating is even more revolutionary.

In Minneapolis a factory has installed the first heating system that has no pipes, ducts or radiators. No matter how cold it gets outside the workers keep warm with the windows open.

Called a direct-fire heating system, it has a huge furnace on the roof that is essentially a giant blowtorch blazing away in a constant airstream sucked in by fans. The heated air is then pumped through the ceiling into the factory. Since 30 thousand cubic feet of air is pumped in every minute, the building is kept under constant pressure. Air escapes through cracks around windows and doors, and the constant pressure eliminates drafts from outside. The especially unique feature is that if any plant worker is chilly, he reaches over and *opens* the window nearest him. Hot air inside the building rushes for the window and warms up his area.

Another heating innovation that will probably never move into the home, but is a natural for offices, factories, stores and schools, is heating from light.

Through a series of eye-wide vents in the overhead fluorescent light fixtures, heated air around the lights is drawn into ducts along with heat escaping from people in the building (about 200 B.T.U./person/hour), heat generated by sunlight streaming through windows, and heat from such things as business machines. This air is collected, sent through a heat exchanger that takes *out* excess heat, boosted by fans and delivered to areas in the building that need heat. The system does contain a heating element that flips on when the temperature outside is too cold for the cycle to operate efficiently. In summer, the heat exchanger pumps excess heat to the outside, and ducts deliver cooled air.

The gas industry's answer to heat from light is called "total energy." The concept is simple. All energy, including electricity, is produced by a single fuel—gas.

The gas drives either an engine or turbine, which turns out normal 60-cycle power, and can produce 420-cycle or 820-cycle power for bigger jobs. Heat ex-

(Please turn to page 238)

These Weldwood® products make your home more weatherproof than Noah's ark.

1. P.A.R.®, a penetrating water repellent exterior stain that cannot blister, peel, crack or craze. Perfect for shakes and siding. Clear or a variety of colors.

2. Patiolife®, the satin redwood-tone sealer-finish for porch and patio furniture. Guards against chalky rub-off, warping, swelling, cracking or discoloration.

3. Woodlife®, the original water repellent preservative for wood. Penetrates and protects fences, outdoor furniture, siding against moisture, rot, insects and decay. An ideal base for paint. In clear or green for marine use.

4. Rainchek®, for brick, stone, masonry and asbestos. It is completely clear, colorless and odorless when dry. It repels water, and resists age, acids, salt air, direct sunlight and heat.

Only United States Plywood makes Weldwood preservatives.

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Now...a motor that FOLDS!

The perfect Christmas gift!

Evinrude's new 3-foot, 3 hp Lightwin folds and fits in a 2-foot carrying case. Goes anywhere (with weedless drive). Stows anywhere — car trunk, closet or camper trailer. Handiest fishing motor ever made. See it now at your Evinrude dealer. He's listed in the Yellow Pages under "Outboard Motors." FREE CATALOG. Send the coupon now for your free copy of Evinrude's new 1966 catalog of motors, boats and Skeeter snow vehicles.

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Send free Evinrude Motor and Boat Catalog for 1966 to:

Name.....

Address.....

City.....State.....Zip Code.....

Hot News in Home Heaters

(Continued from page 236)

hausted from the engine or turbine is captured and used for general heating, cooling (through an absorption chiller), and heating domestic hot water; making it economical. And since the gas flow is continuous, power is never interrupted by severe electrical storms or heavy snows.

When you look into what is lukewarm in the heating industry—in the research labs and on the drawing boards—you're moving onto exotic terrain. They're working on a gas-heated radiant wall, a forced-warm-air gas furnace smaller than a foot locker; better ways to capture solar heat (page 91, Feb. '65 *PM*); plug-in gas heaters and appliances; a gas-driven fuel cell that will produce electricity right in your home.

And the young heating design engineer stares wistfully into space and talks about a plutonium cell no bigger than a transistor radio that is planted in a lead well. It heats, cools and electrifies the home for ten years without changing.

But will it really be as much fun as the bundling board?

Manufacturers' Directory

BOILERS, ELECTRIC
Hydrotherm, Inc., Northvale, N.J.
Precision Parts Corp., 400 N. 1st St., Nashville, Tenn. (drapery valance unit)
Edwards Engineering Corp., 101 Alexander Ave., Pompton Plains, N.J.
W. L. Jackson Mfg. Co., P.O. Box 190, Chattanooga, Tenn.
Siebring Mfg. Co., George, Iowa
International Oil Burner Co., 3800 Park Ave., St. Louis, Mo. 63110
Heat-Timer Corp., 657 Broadway, New York, N.Y.

HEATING-COOLING, RESISTANCE COIL FURNACES
Mathes Air Conditioning Co., 6210 Denton Dr., Dallas, Tex.

HEATERS, SEALED COMBUSTION CHAMBER, GAS
Locke Stove Co., 114 W. 11th St., Kansas City 5, Mo.
Suburban Appliance Co., Dayton, Tenn.
Monogram Industries, Inc., Quincy, Ill.
Temco, Inc., Nashville, Tenn.
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Hupp Corp., Perfection Div., Waynesboro, Ga.
Royal, Inc., Judd Rd., Chattanooga, Tenn.

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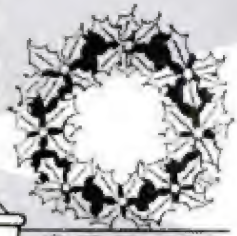

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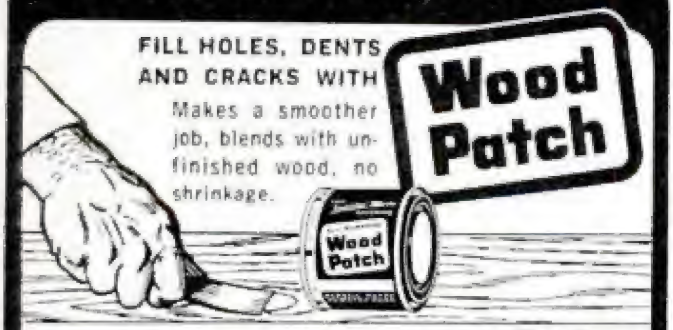

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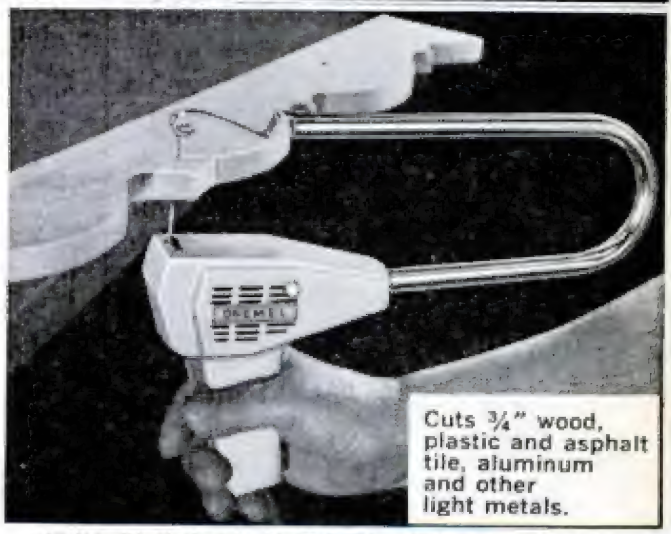

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Motorized Humidifier

(Continued from page 179)

plenum. I used this lid to support the float and snap-action switch. To make the float unit I simply ran a length of ⅛-in stainless steel welding rod (with the flux coating removed) through a Styrofoam block, far enough to bend the projecting end back in a U and into the block again to lock it in place. The other end of this rod is bent at right angles and inserted through a bracket soldered to the underside of the lid, as shown at the top of page 179.

The switch is fastened over a hole in the lid by means of an L-shaped aluminum bracket, the operating button projecting through the lid to contact the float arm. The attaching bolt that's directly over this button goes through a *slot* in the bracket, to provide a water-level adjustment.

Note that the front closure plate is notched to fit down over the water pan. Both the drum-axle-to-motor-shaft and vane-adjustment connections require piercing this plate. The location of these three holes can be determined by setting the plate on the pan and marking its rear face. Only after the motor is installed on the closure plate should you trim off the front excess of the drum axle, and drill for the pin that must seat in the coupling slot (see detail on page 177).

The vane shafts have a washer-stop soldered at the *front*, so they can't be pulled out of their rear supports. Don't drill the various positioning holes in the closure plate until you've attached the adjusting fingers. Even then, take care not to drill these holes all the way *through* the plate since it would permit too much air leakage.

Trial-assemble the whole unit on your workbench to check clearances. Make sure vanes don't touch the drum, and that the motor turns the drum easily. If you're using a solenoid valve, adjust the switch until it snaps off with the water about an inch deep in the pan.

The humidifier is designed for assembly and disassembly right in the plenum, since the drum will have to be removed for occasional cleaning. The water connection to the nearest pipe is by means of a small clamp-on needle valve and ¼-in. copper tubing—the same size tubing you run *from* the valve to the water pan.

The relative humidity in your home can now be controlled by proper positioning of the air vanes: the wider they're spread the more hot air will be forced through the wet drum and the higher the humidity will be. You can either judge it by "feel" or measure the humidity with a psychrometer

(Please turn to page 242)

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If you want to
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here's how!

by Whitey Ford

The famous Major League pitcher who holds the most World Series records tells what happened when he decided smoking was not good for his physical fitness.

I talked to my doctor about smoking and he advised me to quit. I did. But it was hard. Then I heard about a little pill called Bantron. I was surprised to find that it helped a lot to keep me from smoking. Now, when I feel like relapsing, I just take Bantron instead.

Bantron was discovered by doctors in the research department of a great American University. Tests on hundreds of people showed that it helped more than 4 out of 5 of *all* people who wanted to stop smoking to do so in five to seven days. Even those who didn't stop completely had drastically cut down.

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Motorized Humidifier

(Continued from page 240)

(between 30 and 40 percent is the ideal for most homes). Since the furnace blower runs oftener in cold weather when more moisture is needed, the unit tends to maintain a fairly consistent relative humidity, once adjusted. For fully automatic control, add a humidistat which works like a thermostat to turn the unit on only when it's needed. You can buy one for under $10.

The amount of maintenance will depend on the mineral content of the water you use. I supply softened well water to my unit; since it contains a fairly high concentration of sodium carbonate, a white sludge forms in the pan that has to be removed monthly. When water has a low solids content, you'll have to clean pan and drum only once or twice each heating season.

When the system is connected with a domestic water softener, be sure to shut the unit off during the regenerating cycle or a brine solution will be carried into the pan which could cause corrosion. ★★★

Win This Chassis

(Continued from page 89)

relation to its value. Obviously a Suburba-Car should cost less than a ready-made, full-size family car or sports car.

★ Don't forget to write your name and address plainly on every sheet of paper you submit, and tape it to your model, if you decide to submit one.

Entries will be judged by a panel of experts including William L. Mitchell, vice-president, styling staff, General Motors Corp.; Gene Borniat, vice-president and director of styling for Ford Motor Co.; Franklyn Jacoby, ASID/IDI, *PM*'s design consultant; and Wayne C. Leckey, managing editor of *PM*'s Shop and Crafts. The decision of the judges will be final, and professional designers, as well as *Popular Mechanics* employes and their families, are not eligible to compete. Contest is void in states where prohibited or restricted by law. All federal, state and local laws apply. All entries become the property of *Popular Mechanics*, and only one prize is to be awarded.

The winner of the Suburba-Car contest will be announced in our March issue, with a sketch of the prize design. For nonwinners who want to build the chassis for themselves, complete plans will begin in our April issue.

Good luck! By spring you may be driving a handsome new short-tripper that *you* designed! ★★★

Sub-minis—Mighty Midgets

(Continued from page 124)

sinon. This camera is priced at $149.50.

From *PM*'s submini shooting spree several conclusions may be drawn. First and foremost, picture-taking with tiny cameras is fun—a lot more fun than using conventional size cameras. Most of the midgets are light enough so that they are no more trouble to carry than a pen.

How sharp are submini pictures? Judging from our shots, most of the midgets can make negatives that may be blown up to 8 x 10's of thoroughly acceptable quality. Cameras such as the Rollei 16 and Tessina can turn out work comparable to that of all but the best 35-mm cameras.

It's not really fair to compare submini picture quality with shots taken on 35-mm or 120 film. The midgets are not intended to replace larger cameras. Their greatest virtue is portability; you can always have a submini stuck away in your pocket, ready for a fast draw when an unexpected picture opportunity presents itself. Never again will you have to say, "If only I had my camera with me."

Of all the cameras tested, the Minolta 16 II seemed to offer the most for the money: drop-in film loading, an amazingly sharp lens, and full adjustment of shutter speeds and aperture. The Minox, easiest to carry of all the submini's, is so light that it's difficult to hold steady even at normal shutter speeds. Its tiny negative demands the most careful processing. The Tessina takes getting used to. It's hair-trigger shutter release is easy to trip unintentionally. The motorized film advance does not offer any practical advantage. On the other hand, the lens is top notch and the cartridges can be reloaded with standard 35-mm film. The Edixa 16 has a fine lens and an efficient rapid-wind lever but hangs heavier in the pocket than some of the other submini cameras. The Rollei 16 is an easy camera to load and use. It's workmanship and optical quality are superb. A fine camera for the snapshooter is the Yashica 16 EE with its electric eye and fixed focus lens.

Before you buy any submini, check on the local availability of film. The Minolta and Yashica use the same cartridge. The others require special loads that may not be available from your dealer.

On that exciting day when you're ready to shoot your first roll of submini pictures, remember to dust the inside of a camera before loading, gently squeeze the shutter release to prevent camera shake, move in close to the subject to fill the entire negative area, and expose accurately. That's all there is to it. ★★★

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3.
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4.
PLYFOAM CAP RAIL TACKED & GLUED IN PLACE. COVER WITH GLASS TAPE

5.
ROUND PLYFOAM EDGE TO 3/16 RADIUS & COVER WITH GLASS TAPE

(Continued from page 150)

glue and toothpicks to assemble the strips.

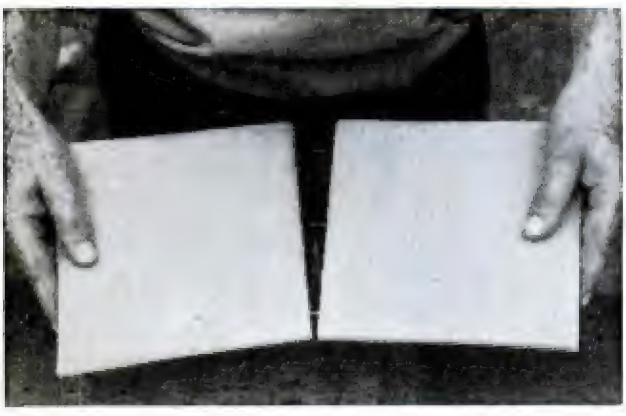
To produce a large compound curve from a single sheet, however, you'll probably have to heat the whole sheet at one time. Where Plyfoam is used in manufacturing operations, a large industrial heating blanket takes care of this. Since such blankets are too expensive for general use, *PM* has designed a simple, low-cost oven which accomplishes the same thing. It's detailed on page 150.

Once the sheet becomes pliable, it must be quickly transferred to the form and anchored in position. A heat lamp used as a supplementary local heat source will help to prevent too-rapid cooling and allow more time for manipulation. It will also come in handy for spot-heating when putting the finishing touches on the shape.

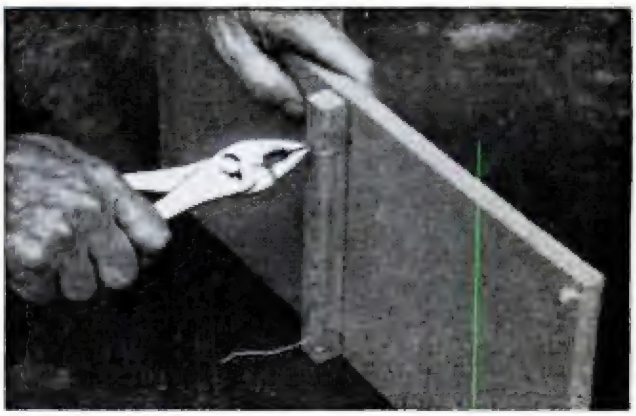
When producing a deep, domed shape from a single sheet of Plyfoam, some surplus material undoubtedly will wrinkle around the edges, just as would a thick piece of felt. Trim off this surplus with a sharp knife. As with any other Plyfoam joint or surface, a few inaccuracies won't matter since the whole thing will be hidden under fiberglass. Cut filler pieces to plug any gaps left by your trimming and glue them in place.

The result of patching up in this way is exactly the same as a continuous sheet in the finished project, so don't worry. And as this implies, every scrap of material can be used up by piecing small projects together, trimming as you go.

When assembling a Plyfoam structure, keep in mind that it will be necessary to have access to *both* sides of the material in order to apply the fiberglass reinforcing layers. Thus, it's often desirable to plan



FLAT BUTT JOINT fastened with adhesive and reinforced with toothpick push pins is even stronger than foam, can be used without weakening structure



ALTERNATE METHOD of securing butt joint while the adhesive cures is to locate it over building frame member and temporarily wire it to the frame itself

your project as two or more subassemblies which can be joined together after each has been fiberglassed.

Fiberglassing Plyfoam. Be sure to follow all the standard safety precautions when covering your Plyfoam project with fiberglass. Work in a well-ventilated area maintained at a comfortably warm temperature (about 75° F.).

Wear rubber or plastic gloves when handling the wet resin. Avoid prolonged contact between wet resin and skin. Wash thoroughly and frequently.

The first step is to spread the fiberglass cloth flat over the shaped Plyfoam and mark it for cutting. For most projects, 10-oz. cloth is recommended. During this preliminary fitting, make sure that joints in the cloth won't coincide with joints in the foam.

Cut all the cloth required at one time so as to avoid delays once the resin has been mixed. Leave between 2 and 4 in. excess at joint edges and about an inch for final trimming to size.

It's extremely important that you follow the manufacturer's instructions when mixing the resin. Measure quantities carefully and *mix well.* Don't prepare the resin until you're ready to go to work, however, for once mixed it will remain in a liquid state for only a limited time. Just how long depends on the type of resin, but an hour is the common period of time. Mix only as much resin as you can conveniently use during this period.

Instead of painting your project, you may wish to add coloring to the resin itself. Special color pastes for use with epoxy are available from most dealers handling resins.

(Please turn to page 246)

FILLET OF FOAM reinforcing right-angle butt joint should be taped with glass so load is effectively transmitted from skin of one panel to the other

ask?

it's worth asking for.

(good things usually are)

PLYFOAM

(Continued from page 245)

Epoxy is the recommended resin for use with Plyfoam; polyester may be used after a prime coat of polyurethane varnish.

With a wide paintbrush, spread the resin evenly over the exterior surfaces of the project. Then lay the glass in the resin and smooth it out. Use a rubber or plastic squeegee to work trapped air to the edges of the glass cloth.

Put enough pressure on the squeegee to work the resin through the fabric, thoroughly saturating the cloth. Remove any excess resin. The finished appearance should show fibers of cloth evenly wetted with resin over the whole surface. If "dry" spots persist, work a little resin into them with the brush and squeegee.

Finish off the outside of the project in this manner, adding reinforcing strips of cloth along all angle joints. The joints between pieces of cloth may either butt squarely or overlap slightly.

As soon as possible, remove the project from the frame and cover all inside surfaces. This will eliminate the possibility of warping which might arise due to one layer curing without the stiffening effect of the second layer. With a layer of glass on both sides no warping will occur.

On larger structures requiring even greater rigidity, apply two layers of glass to each side. Such a sandwich will be strong enough for practically any project; 40-ft. sailboats have been built from ½-in. Plyfoam with just two layers of 10-oz. glass on each side.

While the glass cloth texture makes a satisfactory and pleasing finish, you may wish to have a smooth surface. If so, fill the surface with epoxy or polyester filler and sand it down; paint with an epoxy or polyester paint and polish when dry.

On projects involving flat surfaces or simple curves, unusual effects can be achieved by substituting other rigid sheet materials for glass on one side of the Plyfoam. Embossed aluminum and Formica are two obvious choices.

Again, with flat surfaces or simple

(Please turn to page 248)

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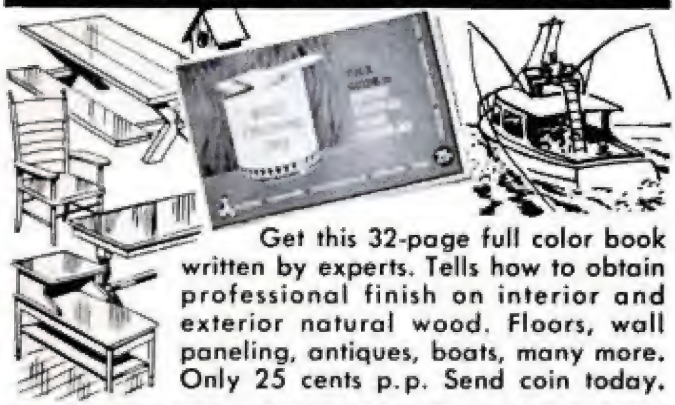

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Often Called The Drinking Man's Diet

WASHINGTON, D. C. (Special)—This is the revolutionary new low carbohydrate diet that everyone is suddenly talking about. It is known variously as the Air Force Diet, the Astronaut's Diet, the Airline Pilot's Diet, and sometimes popularly known as the Drinking Man's Diet. In effect, it allows you to drink all the liquor you want, enjoy formerly "forbidden" foods such as big steaks trimmed with fat, rich gravies, mayonnaise, lobster swimming in butter, bacon, fats, sausages and scrambled eggs—and still lose 10-15 lbs. a month. **This is the one diet that really works.** Senators in Washington, D. C., and Members of Parliament in Ottawa, Canada, report losing 40 to 50 pounds with ease. Women report equally startling results. Calories play no part in this diet. What you do is count your carbohydrate grams, and limit your starch and sugar intake to 60 grams daily. The reason for this is simple. When your body doesn't burn up all starches and sugars you eat, the excess carbohydrates quickly turn into unsightly fat. On a low carbohydrate diet your body is forced to call on its own fat (stored carbohydrates) for energy and thus you lose fat. When the fat is gone you will cease to lose weight, and your weight will remain constant. Counting carbohydrate grams is easy. The new Air Force diet manual lists the carbohydrate content of over 1,500 foods and 50 alcoholic beverages. And gives the detailed rules to follow this new diet. It also gives typical low-gram menus that are every bit as pleasant as not dieting at all. The new Air Force diet manual was primarily designed for Air Force personnel to keep in fighting trim. But it has proven to be more than that. It has proven to be a Godsend for people who hate dieting—who find salad without dressing unbearable, eggs without bacon unthinkable, dinner without martinis uncivilized. In short, if you like to live well and have a weight problem, this new diet manual will change your life, as it has for thousands of others. Recently published as a private edition in Canada, the diet manual can now be obtained by sending $2 to AIR FORCE DIET, Room 104, 92 King Street East, Toronto 1, Canada. Unconditional money back guarantee. If after trying the diet for 30 days you have not lost 10-15 lbs., simply return the diet manual and your $2 (plus postage) will be refunded promptly and without argument. Tear out this message as a reminder. Decide now to regain the trim attractive figure of your youth—while still enjoying hearty breakfasts, lunches and dinners—and drinking all the liquor you want. Order now before others snap up the limited supply.

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(Continued from page 246)

curves it's possible to produce custom decorative panels by borrowing some of the standard techniques of fiberglass molding.

A Formica surface can serve as the mold. Apply a layer of wax "parting coat" (you can buy this from any fiberglass supply house) and spray or brush a layer of clear resin over the wax. Lay a patterned fabric on the resin, pattern down, and over this lay a layer of glass fabric saturated with resin. Apply another layer of resin, then the Plyfoam, and finish with a final layer of resin and glass fabric.

Once everything has dried, remove the Formica mold and you'll find a high-gloss clear finish protecting the patterned fabric.

Alternatively, this process may be used to produce a high-gloss colored surface by using colored resin.

To attach fittings, handles and hinges to a Plyfoam project you may either add wood inserts in the Plyfoam core before fiberglassing or drill holes in the finished laminate and install fiber or plastic screw anchors with adhesive.

Load-bearing attachments can be glassed into position and reinforced by applying

Boat Building (Continued from page 155)

The Sea Shell pram can be put together without heating the Plyfoam. You simply pin the pieces together around the frame with annular-ring nails (which are included) and cover the hull with fiberglass. Complete plans and building instructions are included with the kit. In general, however, the construction procedure follows that outlined earlier for making any Plyfoam project.

Samples available. If you would like to obtain samples of Plyfoam to experiment with in your shop, send 25 cents to Popular Mechanics Bureau of Information, 575 Lex-

TOUCHE III, John Potter's big trimaran, was the first boat to be built of Plyfoam. The cat-rigged boat carries 650 sq. ft. of sail on a 51-ft. mast

15½-FT. TYPHOON runabout from McNair Boat Works sells for $749.95 in kit form. Except for a wooden deck and transom, it's made entirely of Plyfoam

10-FT. TUNNEL HULL is a research prototype from Plyfoam, Inc. Unsinkable, it contains enough flotation to keep five people afloat, even when holed

successive strips of fiberglass at different angles.

A wide variety of edge treatments is possible. For a square edge, cut back the Plyfoam and fill the edge with epoxy or polyester filling compound of putty consistency. Sand the edge smooth and paint it. For a rounded edge, just file the edge round and cover it with fiberglass tape.

Capping strips can be mounted with epoxy adhesive, or you can make up Plyfoam "nosing" and fiberglass over it.

Don't be afraid to let yourself go when working with Plyfoam. It has tremendous potential and the main need for taking full advantage of its possibilities is a generous helping of imagination. ★★★

ington Ave., New York, N.Y. 10022. You'll receive two small strips of foam—one uncoated so you can try out its thermoplastic characteristics and the other sandwiched between two layers of fiberglass to give you some idea of the strength the material offers for project use. ★★★

LIGHTWEIGHT PRAM is another Plyfoam prototype. Both pram and tunnel hull may eventually be offered to the public, possibly as mail-order kit boats

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Deal for the Harried Commuter

(Continued from page 104)

line control. Cars thus can speed along, virtually bumper to bumper, at 50 mph, the projectile into a fanjet-like engine and exhaust it in precisely calculated quantities that would not appreciably disturb the main air mass in the tube. Primary propulsion would be from another engine at the rear of the vehicle, perhaps a bladeless propeller invented by Dr. Foa. The vehicle would be centered in the tube by ground-effect jets.

Because one of the major obstacles of attaining high speeds in other type vehicles—drag from air made turbulent by the act of ramming through it—would be eliminated, great speed could be attained with remarkable little power.

This system has been tested in model form. Now Dr. Foa hopes to build a pilot version in a tube three miles long.

"In fact, from the standpoint of technical feasibility, construction of a system with speeds up to 300 or 500 mph could be undertaken immediately."

Another proposal goes back to the old pneumatic-tube system used years ago in department stores. A capsule is pushed into a vacuum tube and the air pressure behind it literally "whooshes" it to the other end. In the tube train, which runs on rails, the "en route" portion of the tube is evacuted of air while the station areas are at normal atmospheric pressure. A valve is opened allowing the train to enter the tube, and the air pressure behind it accelerates it up to 300 mph. The valve allows just the right amount of air to push the train to its next station.

At about the midway point, with the train now compressing the air in front of it, the air before and behind it are about equalized and the air before it now acts as a brake, slowing it down for its next stop. Acceleration and deceleration valves at the stations, and crossvalves to an adjacent tube, contain or release the air in the tube as necessary.

Meanwhile, out on the highway, a new era is about to embark, that of the automated trip. A harbinger is General Motors' proposed "Autoline," a complete speed and directional control system for vehicles, using remote-control electronic signals. Its main components are the inevitable computer, a control cable beneath the automated highway lane, and sensing devices and servo-mechanisms in automobiles that can actuate their controls. When perfected, Autoline will let drivers "phase" into an automated expressway lane with their cars completely in command of the auto-

(Please turn to page 252)

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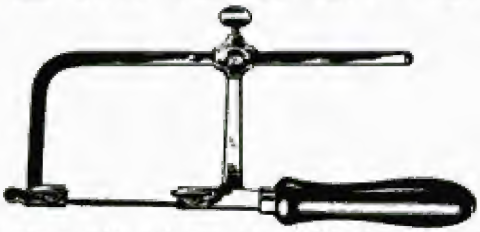

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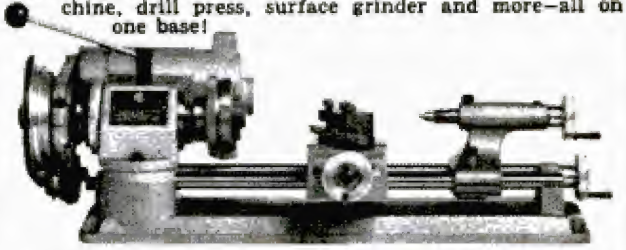

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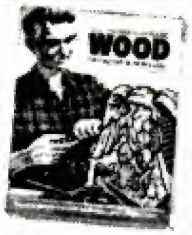

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Deal for the Harried Commuter

(Continued from page 250)

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A variation for motorists is the "Rolway," a "piggyback" freight technique to carry autos and their passengers on high-speed automated trains. Designed by the General American Transportation Corp., the system would utilize streamlined trains four times the width of a standard-gauge rail line, operating approximately five minutes apart along turnpikes and other major traffic routes. This would enable motorists starting a trip to drive aboard and park parallel to other autos, stroll to a passenger lounge, then, on arrival, resume their trip by auto.

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In air travel, efforts to design and place in service a supersonic airliner by 1970 are well known. Less familiar, however, is another development of almost equal significance, vertical takeoff and land planes (VTOLS). Some, using jet engines, blow the air down for takeoff and landing, and rearward for forward cruise. Others, using props, tilt the engines or tilt the wings. The most recent, the Bell X-22, uses four ducted props, tilting them up or down for forward or vertical flight. Success of any of them could lead to transports that could carry passengers from downtown areas, bypassing hard-to-get-to airports.

In water travel, the most significant advance since the steamboat has arrived, the hydrofoil liner which lifts from the water and rides on low-friction, airfoil-shaped "legs." Many hydrofoils are now operating in such varied locales as the Rhine River, on Italian and Swiss lakes, the Mediterranean, Baltic and Adriatic Seas, and are carrying passengers between Manhattan and the New York World's Fair. The U.S. Navy and Maritime Administration are experimenting with hydrofoils; one, built by Grumman Aircraft Corp., an 80-ton ocean going craft, and another, built by the Boeing Co., an awkward-appearing test vehicle designed for 115 knots!

All this is only a sampling of changes that lie ahead. Man, while exploring space, is also launching a transportation revolution on earth, one that may be even more far-reaching for most people. ★★★

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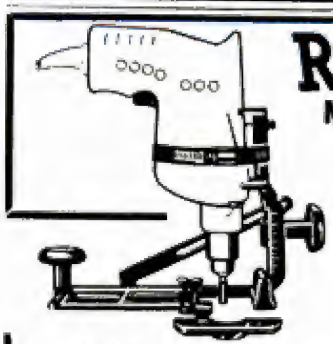

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Transportation's Missing Link

(Continued from page 87)

and the like simply do not appeal to comfort-loving Americans.

The lack of appeal is especially true in major cities where there's a wide range of temperature and there's much rain and snow. As it happens, most of our large cities fit this description.

In addition, the rider of the small vehicle is intimidated by the behemoths that share the road with him. The solution to this problem is to have protected right-of-ways separate from automobile traffic. The eventual solution must be to separate completely the cars from local pedestrian and personal vehicle transportation. This has been done in many cities of Europe where there are three separate traffic lanes: pedestrian, cycle and auto.

The ultimate answer to the urban transportation problem—in terms of safety, economy, speed and land use—is to have high-speed mass transit to carry the very small personal vehicles that riders use for short trips to and from terminals. Already such plans are being proposed to deal with the aggravating traffic problems now upon us.

Several Institute of Design students have tried their skill at designing vehicles of this sort.

Sparky Is a Hitch Hiker

Sparky, for instance, is an electrically powered runabout that's fitted with a smoothly contoured aluminum body (photos, pages 86-87). It can travel 30 mph, and goes 60 miles on one charge of its batteries. Granted, it's a rather modest performance compared to a gasoline-powered car, but Sparky was conceived as a systems car to be shipped at distances over 25 miles by special high-speed rail transportation.

Another piggyback people-carrier is the Power Chair, which is simply a seat on wheels (photo, page 85). It travels up to 45 mph powered by a 4½-hp four-cycle engine.

After carrying a commuter to his train, then being transported into the city, the Power Chair could be driven to the office. Student Douglas Stout designed it.

But, even with all this thought going into design of small cars, how do you get Americans to accept them? We talk of speed, comfort and safety when we defend big cars, but it's primarily for the symbolism that Americans want their cars to be as big as possible.

Small cars seem to be less acceptable to Americans because of a common fallacy

(Please turn to page 256)

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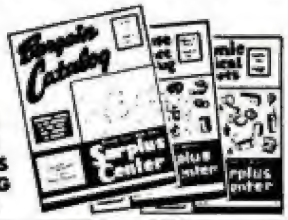

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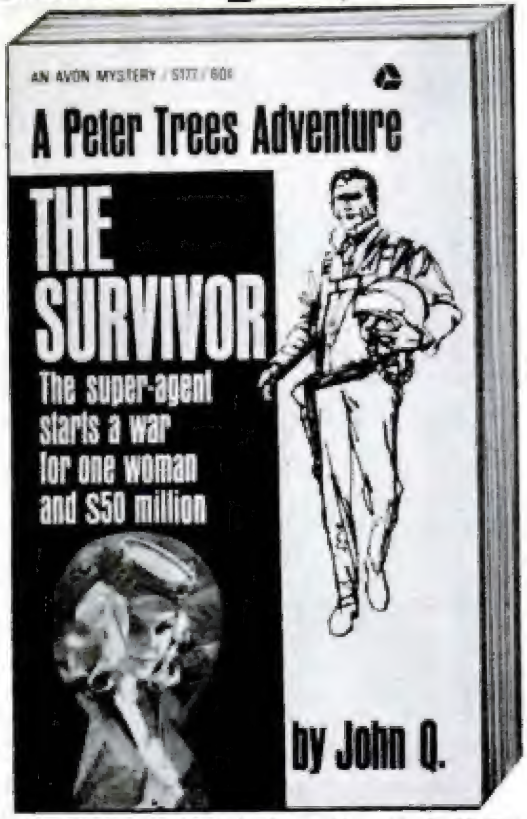

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Transportation's Missing Link

(Continued from page 254)

that they are cheap cars. There have been a few small American cars that were well made. The automobile is designed to cater to the symbolic fantasies of prestige, opulence, comfort, youth, speed and so on held by the individual buyer. Designing is done in utter disregard of the total transportation system.

It is certainly not size nor weight that makes for good performance. The most roadworthy cars are the smaller ones. Comfort is not a function of size.

Two big forces will change people's attitudes toward accepting innovations in personal vehicles. The first is the steadily increasing use of malls. Most new shopping centers are being planned around pedestrian areas; the automobile must be left outside. Many major cities are proposing mall plans for the downtown areas in cities. This will change transportation systems as these plans grow.

The second force is the rapid growth of automobile rentals. All three major automobile manufacturers now have rental plans. As the idea grows, it will undoubtedly break down the symbolism of the car as a personal possession. The result should open the whole subject of vehicle design as applied to personal transportation.

Dismay or Delight

Whenever the vehicles built by the Institute of Design students are shown, the responses are both of dismay and delight. Those who don't like the machines find them crude and uncomfortable. Those who find them interesting and fun, compare them with sporting devices such as surfboards, karts and skis; in short, the fun is back in transportation.

Our transportation networks are very crude. All the pressures of a fast-developing urban civilization will force changes. Perhaps the vehicles shown on these pages are a hint of the answer.

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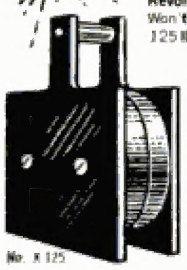

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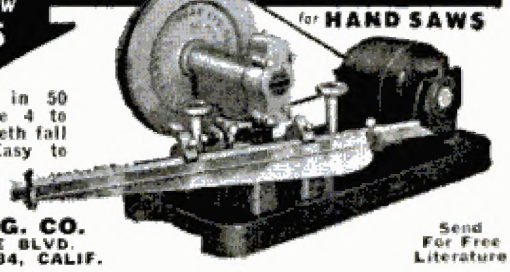

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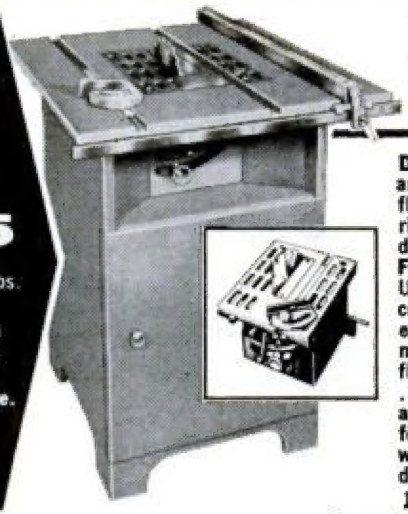

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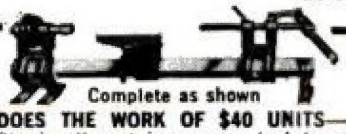

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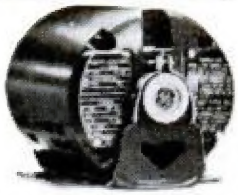

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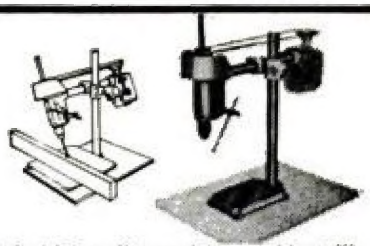

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